

Roughriders of the Deep

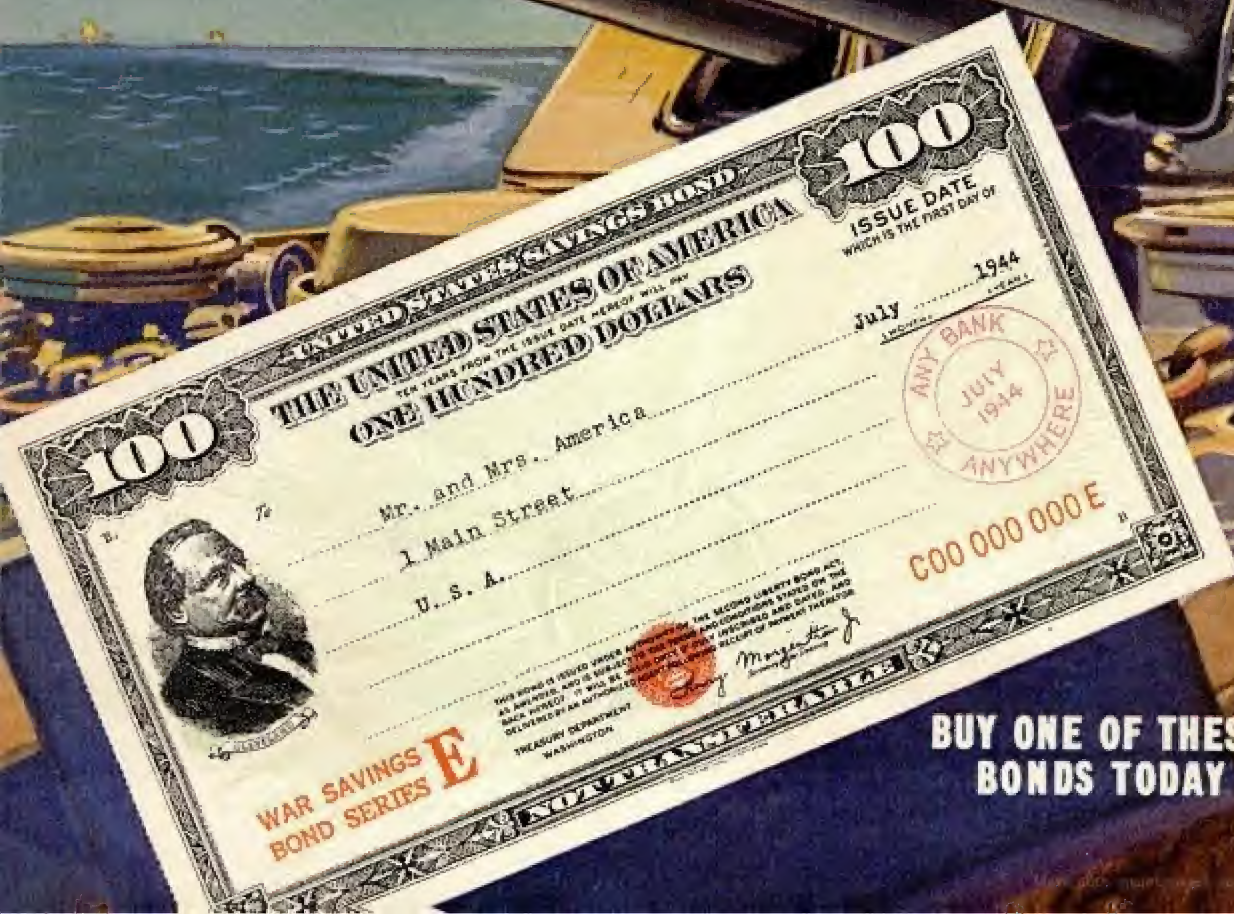


POPULAR MECHANICS

MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

JULY
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And an important reason why Fisher Body has yet to fail at a war job is because craftsmanship has never yet failed us.

Every Sunday Afternoon
GENERAL MOTORS SYMPHONY OF THE AIR
NBC Network



armament
~~BOX~~ BY

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No longer strangers are the people opposite us on a world steadily growing smaller. The ways of life in all parts of the world will be as familiar as those of your next door neighbor.

There is no doubting the importance of short wave radio in the postwar world... important in bringing about a better understanding between nations—aiding the progress of civilization and bringing to all peoples the *good* things in life.

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1A

JULY, 1944

ARMY AIR FORCES



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LET'S ALL BACK THE ATTACK—BUY WAR BONDS

Popular Mechanics Magazine

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H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

July, 1944

Vol. 82, No. 1

Next Month

ONE of the sportiest fishing grounds off Long Island's tip is closed to the millionaire anglers just now. It is a wartime hunting ground for tin fish. The torpedoes that are sinking Japan's fleet get their start here in a testing ground, where Navy inspectors peering through glasses watch the course of each \$10,000 tin fish as it makes its trial run from a tube or its simulated drop from a torpedo plane. Speedboats rush to retrieve each torpedo, guided sometimes by observation planes. Read about this torpedo proving ground in the August feature, "Torture Tests for Tin Fish."

"Going Up!"

AIR FORCE mechanics in Alaska sometimes harness three gasoline-fired air heaters in tandem to produce enough warm air to start an airplane engine suffering from the arctic chill. But it's hot in Alaska compared with the cold room in Douglas Aircraft's laboratory, where the thermometer may hit 130 below zero in a test of men and instruments for service at 50,000 feet up. What goes on in the cold capsule is related in an article next month.

Air Made to Order

IMAGINE a cool, brisk day in the New Guinea jungle or a smokeless day in Pittsburgh. It's not impossible. Postwar tourists may put up in comfortable air-conditioned inns on South Pacific isles, electrostatic air cleaners may eliminate smoke in our steel cities, and, says an article in the August issue, there's a promise of dustfree comfort for your home.

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The Shape of Things to Come

WHEN the tremendous pent-up desire for new homes and new automobiles, television and helicopters and just plain electric irons is loosed by the hoped-for Armistice whistles, what will American industry have to offer? Probably very little, at the moment. But the designs are on the drawing boards—and some of them you will see in an eight-page feature next month: "The Shape of Things to Come." The story tells of a molded bathroom-and-kitchen unit, functionally designed, ready to plug into foundation outlets; cordless electric irons, automatic machines that drive drudgery from the home.

Fire From the Sky

AERIAL photographs by the "rec" pilots who follow the bomber fleets show acres of roofless buildings in Berlin. Incendiaries had done an efficient job. An August article tells of one raid in which close to 350,000 fire bombs were dropped on the Nazi capital—incendiaries formed 98 percent of the entire bomb load. Our experts say their new "matchsticks," defying all extinguishing agents, are more effective than two-ton blockbusters for destroying enemy arms factories.

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THE **HOW AND WHY** OF

USE OF WILLIAMS' THREADING TOOL HOLDERS



Thread cutting in the engine lathe is one of the most exacting lathe operations, and one which requires a thorough knowledge of change gear principles and procedure. However, the accuracy and quality of the final job depends upon the cutting tool itself. An explanation of the proper application of two types of Williams' Threading Tool Holders follows:

EXTERNAL THREADING WITH WILLIAMS' LOCKABLE SPRING-HEAD HOLDER



Made in 3 sizes for cutters 1/4", 5/16" and 3/8" square.

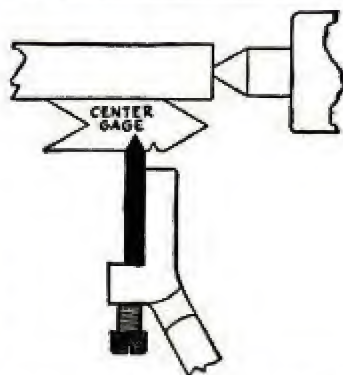
This tool is designed for both fine and coarse threading. Its Spring Head is equipped with a Locking Nut which provides the rigid backing required for heavy cuts; when loosened, the Holder becomes a Spring Tool for finishing work. Finished High Speed Steel cutters are furnished with this tool having each end ground to a "V" point forming an angle of 60°.

To set the Tool, first adjust the cutter so that only the ground portion projects beyond the holder. Now set the Holder in the Tool Post, adjusting the cutter

WILLIAMS

DROP-FORGED TOOLS

Application of Threading Tool. Center Gage must be held parallel to the machine bed ways when setting tool.



point vertically to exact center of the work. Then place a Center Gage with its back edge in contact with the work, or the Tailstock Spindle, and adjust the Tool horizontally by fitting the cutter point exactly into the 60° angle notch in the front edge of the Center Gage. (see illustration). Tighten the Tool Post Screw, using caution not to change position of the Holder. Apply cutting oil to the work generously when threading steel.

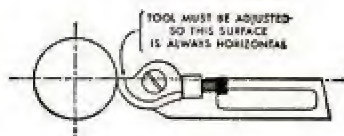
EXTERNAL THREADING WITH WILLIAMS' FORMED-CUTTER HOLDER



Made in 4 sizes, with formed cutters 5/16" to 5/8" thick.

The High Speed Steel Formed Cutter with which this tool is equipped is ground to an included angle of 60° and is backed off for correct clearance. In regrinding, the top edge only is ground, thus assuring a point of proper form and angle as originally supplied.

Procedure in setting this tool is the same as explained for the Spring Head Tool. In adjusting height of Tool so as to center on the work, do not use the Stop Screw on the side of Holder. This adjustment is used to compensate for metal removed from the cutting point in regrinding. The top surface of cutting point must always be horizontal when threading. (see illustration).



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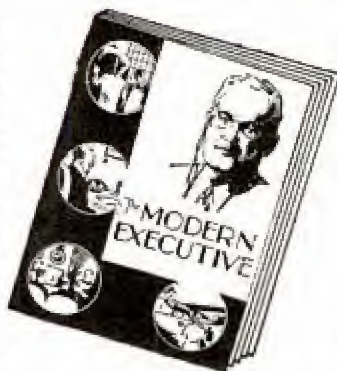
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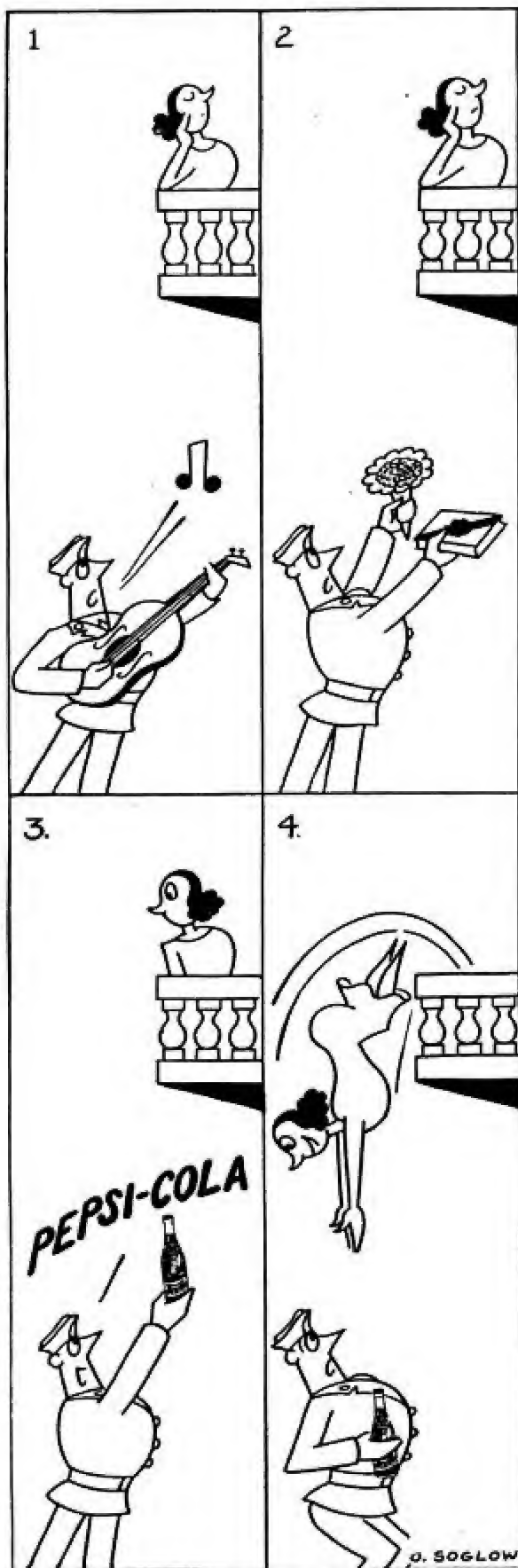
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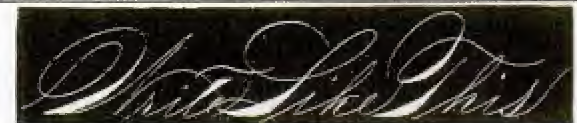
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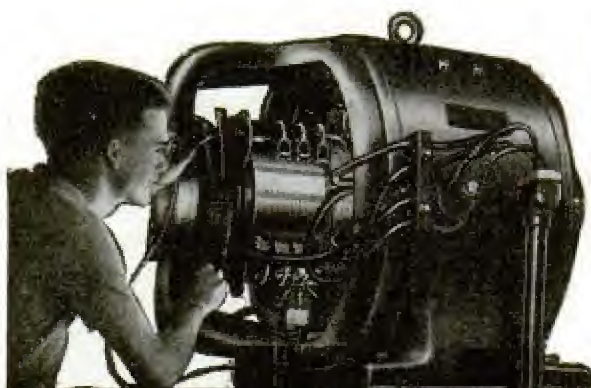
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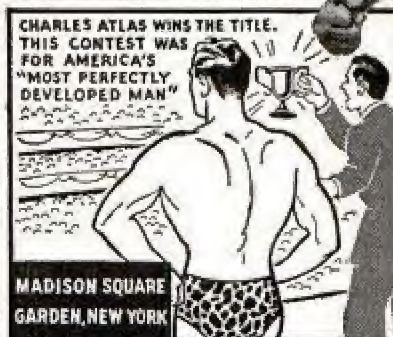
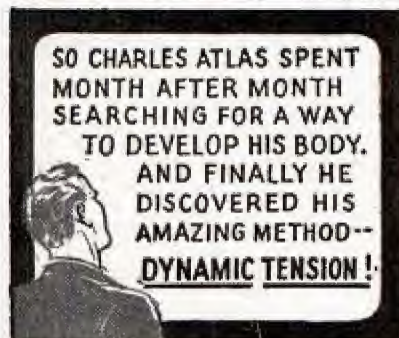
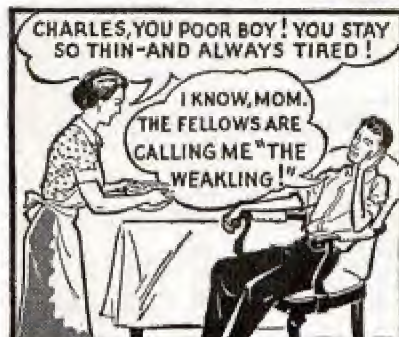
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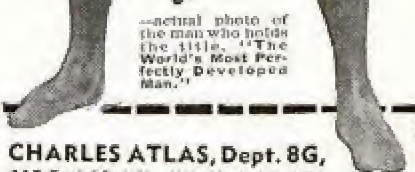
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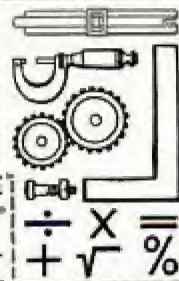
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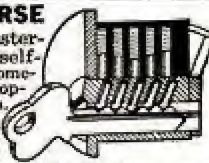
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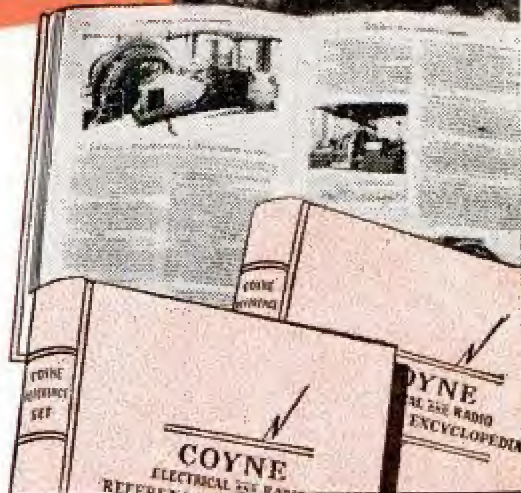
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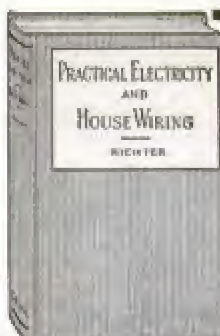
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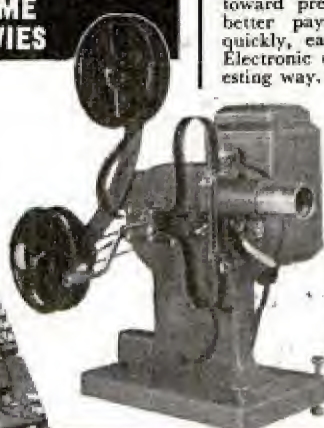
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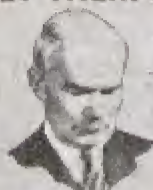
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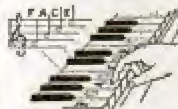
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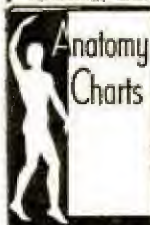
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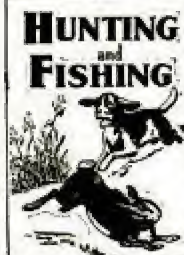
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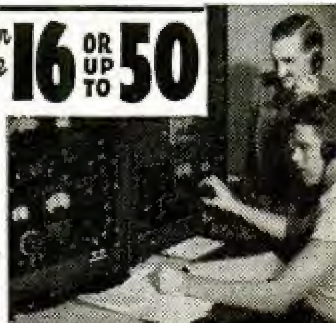
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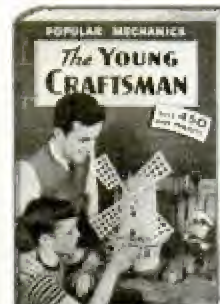
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0 211

Vol. 82

JULY, 1944

No. 1



Two British torpedo cowboys wearing divers' helmets and oxygen masks ride their weapon on the surface

AN ALERT lookout might have noticed a suspicious object moving slowly across the dark waters of Palermo harbor, rather like two bumps on a log.

But the Axis ships in the Sicilian port lay snug within the harbor's antisubmarine net, the tiny screw propelling the mysterious intruder churned silently and if there were sound detectors listening, they failed to pick up the throb of the British submarine's motor off in the distance.

The two "cowboys" dived their torpedo as they reached the protective net, slipped under it and head-

ed straight for the brand new cruiser, the *Ulpio Traiano*. Reaching its side undetected, they detached the warhead and fastened it to the hull of their victim. Then they remounted the after portion of the torpedo and guided it away.

Minutes later there was a terrific explosion, and the cruiser went down a flaming

wreck, dead before she had struck a single blow at the United Nations. Some distance away in the harbor there was another blast, and the 8,500-ton transport *Viminale*, lying alongside the jetty, was torn open so se-

AUGUST ISSUE OUT JULY 20

The August issue will be on sale and will be mailed to subscribers about July 20, somewhat later than the previous publication date. Beginning September 1, your Popular Mechanics Magazine will appear regularly on the first day of the month of issue. The September issue, for example, will be out September 1



In the scene above a torpedo launched from submarine outside enemy harbor creeps quietly toward target



Above, rear man dismounts to lift net protecting harbor and let torpedo pass beneath. Photo shows how the "cowboys" act as their own periscope



verely she sank later while being towed away for repairs.

The human torpedo that made those successful attacks in January, 1943, was one of the best kept secrets of the war—at least a secret from Allied civilians. The Axis may have learned something of its operation by experience and by capture, for all six of the daring British submariners who jockeyed the three torpedoes inside Palermo harbor that night were made prisoners after two of the weapons had attained their objectives.

German and Italian navies are reported to have tried similar weapons during this war, but there is no confirmation

that they were successful. An attempt by Italians to ride an explosive mount into Gibraltar's harbor was reported, and one maritime officer reported the Nazis had tried riding their torpedoes over submarine nets.

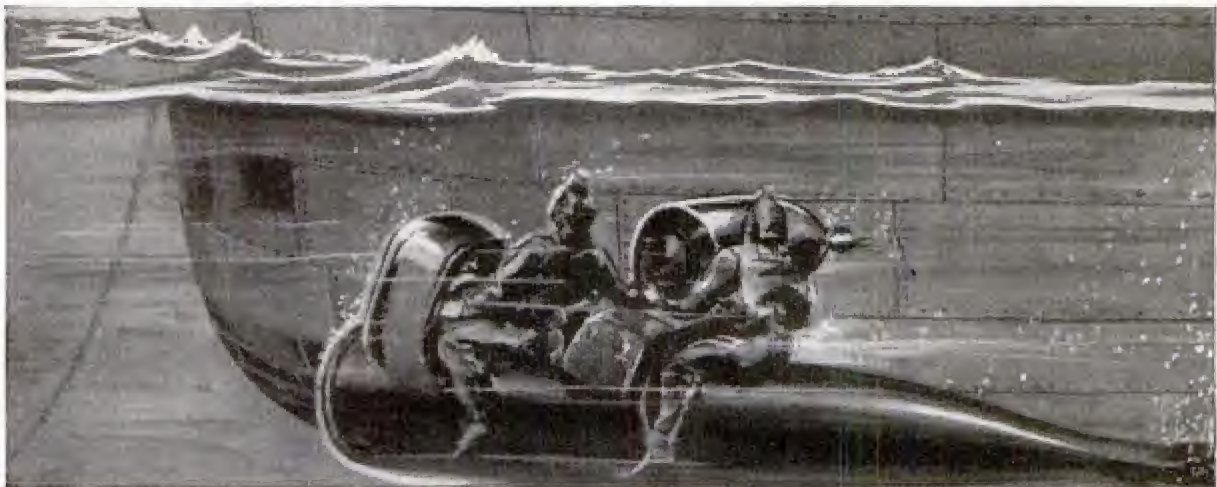
First official announcement of the Allies' "torpedo cowboys" came when the British Admiralty recently awarded decorations to the six who reached shore safely and became prisoners at Palermo.

The torpedoes are submersible, but most of the way to the target they are ridden close to the surface, the heads of the two crewmen above water like human periscopes. Instead of the high-powered engines that drive conventional torpedoes at speeds approaching 60 miles an hour, these mounted torpedoes creep slowly and quietly under propulsion of electric motors that make no more noise than an electric fan. The warhead contains up to 500 pounds of explosives. The men wear diving suits and straddle the torpedo, behind breakwater shields. On reach-

Continued to page 162



Oxygen supply permits the men to remain under water for short period. Here the glass face mask is lifted.



Approaching the target unseen, the men detach the warhead of the torpedo, fix it on victim's hull and set time fuse. In the interval before explosion (below) they have time to ride aft portion of torpedo to safety



Collapsible Lifeboat Holds 25 With Provisions for 30 Days

77 886



hand pump is also provided to maintain pressure in the buoyancy tubes as required. Bulkheads or individual air chambers in the buoyancy tube keep the raft afloat even if it is damaged, and a complete repair kit is provided. Also, there is a removable and inflatable bottom, capable of acting as an auxiliary raft since it can also support a full complement of 25 passengers. This bottom also insulates the occupants from cold and dampness, while a weather cloth, attached to the side of the boat by ropes and wood stanchions, protects the occupants from wind and rain.

0 111

Counter Records 9,000 Coil Turns Per Minute

Nine thousand revolutions a minute can be wound easily on coils by means of a coil winding counter operated by a flexible shaft. The shaft permits the placing of the coil and the counter close together so that both may be viewed at the same time without any strain on the operator.

Because it folds away into relatively small space, yet when inflated will hold 25 persons and provisions to keep them alive for 30 days, the world's largest rubber lifeboat, recently tested by the Coast Guard, is expected to be of increasing importance aboard ships of the United Nations. It fits into a pack 5 by 7 feet by 18 inches, or any comparable cubic dimensions, small enough to be lashed to the side of a ship's cabin and still leave sufficient room in a passageway, and can be inflated in a matter of seconds. Many such pneumatic boats could be packed aboard one transport. It consists of a buoyancy tube, 24 inches in diameter, and three inflatable cross tubes, which provide seats for the occupants and make for lateral stability. Occupants have a space 21 feet by six feet, in which are fastened six lateral six-foot seats. When inflated with compressed carbon dioxide, the 25-foot craft has a 10-foot beam. A



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Production Instrument Co.
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Cadets Learn to Fly in an Earthbound Trainer 0100

Student flyers are making their first "flights" in an earthbound training craft that is controlled in its ground maneuvers in exactly the same manner a conventional plane is controlled. Its seven-horsepower engine can't lift the preflight trainer from the ground, but it can attain a speed of 35 miles per hour, and at 10 to 15 miles an hour the tail rises and the plane is "flown" by manipulating the rudder and control surfaces of the wings, which are in reality exaggerated ailerons. The craft is a tail-wheel type, its front wheels supporting the weight of the plane but not balancing it.



While incapable of flight with its 7-horsepower motor, this preflight trainer built by California Aero Glider Co. teaches the use of rudder and ailerons



"Armored Greyhound" Outruns What It Can't Outshoot 0142

Able to outrun anything it cannot outshoot, the army's M-8 is a six-wheeled, seven-ton, heavily armored reconnaissance car which can travel at high speed over almost any terrain and is capable of ascending a 45 percent grade. Known as an

"armored greyhound," it is equipped with a 37-mm. antitank gun and a .30-caliber machine gun, which move as a unit in the manually operated rotating turret. The four-man crew is protected by armor plate, with the driver and his assistant having protected vision through steel shutters and by indirect devices called protectoscopes. The car, a secret until recently, resembles a turtle-back in construction and its armored hull, which also serves as a chassis, presents a low silhouette to enemy eyes. The motor is cradled between two sets of power-driven axles, which make the rear end of the car a four-wheel drive. When the going gets tough, the front wheels also are engaged.



The car can be operated almost normally even if its special combat tires are punctured by enemy bullets

JULY, 1944

*Ford Motor Co.
Chicago & St. Paul plants.*

0131

Chemical Waterproofs Soil To Make Roads 'Mudless'



*Stabino Powder Co.
Wilmington, Del.*

Treated core of soil at right remains solid through half-hour experiment but untreated core turns to mud

Streets and country roads may some day be "mudless" all the year around as the result of the development of a resin compound which makes the soil waterproof. The "mudproofing" is accomplished by mixing a new product called Stabinol, a patented resin compound derived from pine resin, with the top few inches of soil. This gives a surface which will remain dry for several years. Water will drain off or evaporate, rather than seep through the treated soil and turn into mud. The surface also resists the capillary rise of moisture from below. Although the treatment does not increase the load-bearing capacity of the soil, it keeps it from getting wet and thus losing its strength. It has been used successfully on roads, airplane landing

fields and other construction projects. Experiments with two dishes of soil, one treated with Stabinol and one untreated, show that twenty minutes after water is poured into the dishes, the untreated core of dirt has dissolved into mud, while the treated soil is unchanged.

0192

Plastic Ribbon Doubles for Hair In 'Strato' Weather Instrument

Human hair used in weather instruments to gauge humidity in the substratosphere may be replaced by a plastic ribbon. The plastic element, known as the electric hygrometer strip, is used in a moisture meter developed by the Friez instrument division of Bendix Aviation Corp. It is attached to the radio sonde which is carried 10 miles into the air by free balloons. Changes in humidity produce varied electrical characteristics in the plastic. Human hair varies in length with moisture changes. The plastic ribbon is said to be more accurate.

*Baltimore, Md. - Central Ave.
Baltimore, Md.*

0137

Midget Motor of 30 Horsepower Does Work of 665-Pounder

Built to drive the propellers of small warplane models being tested in wind tunnels, a 57-pound projectile-like motor develops a horsepower equal to that of a 665-pound engine. The small motor with a 30 horsepower rating is only five inches in diameter and 13 inches long. It is water-cooled and has a rated speed of 6,000 revolutions a minute.

General Electric Co. Schenectady, N. Y.



0147

Ack-Ack Rocket Guns Throw Hail of Shrapnel

While the Germans have been letting drop rumors about their secret rocket weapons, unpublicized rocket guns have been playing an important and a spectacular role in defending London from enemy air attacks. When German raiders sweep over the city, the rockets burst in umbrella patterns against the night sky and a sheet of shrapnel comes down from each exploding rocket like a hail storm. The guns have been used for about two years with great success against high-level as well as dive bombing.



0172

Miniature German Tank Controlled by Cable

Although it is so small it looks like a toy, the Germans' crewless miniature tank, called the "Beetle," is said to carry 1,000 pounds of explosives. It is about six feet long and is controlled by radio or electric cable. The tank was used against the Allies in the beachhead fighting at Anzio, Italy, and on the Russian front. Red Army soldiers succeeded in stopping the mechanical pest on many occasions by sneaking around behind it and cutting its cable. Several of the vehicles were captured by the Americans in Italy.



This robot tank, looked on hopefully as a secret weapon by German staff officers, is guided toward enemy by cable or radio

0170

Nazis Put Mine in Wooden Box To Foil Metal Detectors

To foil devices which can detect metal, the Germans planted a new type of anti-personnel mine in small wooden boxes as part of their efforts to halt the Allied advance in Italy. In examining the nonmetallic mines, sappers found the detonators were only about twice as big as a cigarette.

This harmless-looking detonator hidden in its little box could maim a soldier



*Shaw-L. Martin Co.
Baltimore & Md.*



PARLOR



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OVER 80,000 POUNDS

IT IS July 15, 1948. The telephone rings at the information desk in the New York office of a major air line.

"Any planes leaving today for Mexico City?" asks a businessman.

"The usual 10 daily flights," the clerk replies, "either local or express. The express will get you there in eight hours and 12 minutes. The local takes an hour and 14 minutes longer."

"How much is the fare?"

"One way is \$61.50; round trip \$110.70. May I refer you to the reservation desk?"

"Okay," says the businessman.

"Pleasant trip to you," says the clerk.

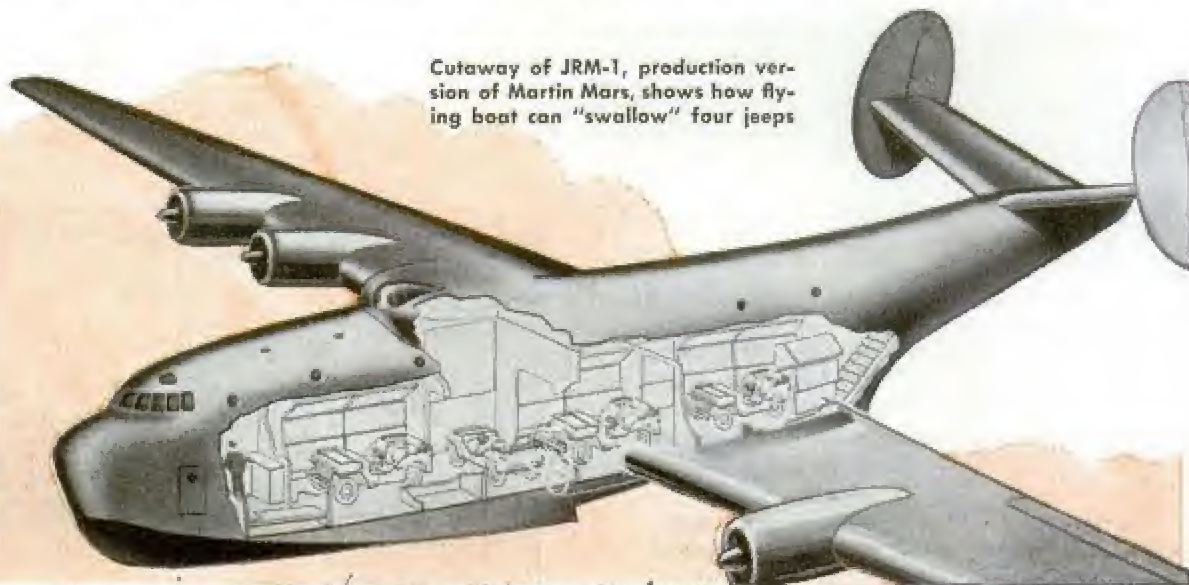
And it will be just that—pleasant—aboard one of the super airliners of the future. Some of these ships are now being tested for postwar service; others are in the mockup stage or on drafting boards. On these planes—tomorrow's

The cozy trio affords a preview of post-war travel in the clouds aboard Consolidated Vultee's Model 39. Among transports to be converted for luxury travel is the sharklike Lockheed Constellation (above)

parlor cars with wings—the passenger will be king. The guy who once thought he was lucky to get a free stick of chewing gum and a glass of ice water will accept such luxury items as "pillow" radios in stride.

Seats for passengers will be the last word in comfort, and the berths will have extra breadth and width. All

Cutaway of JRM-1, production version of Martin Mars, shows how flying boat can "swallow" four jeeps



*Consolidated Vultee Aircraft Corp.
San Diego, Calif.*

CARS *with* WINGS

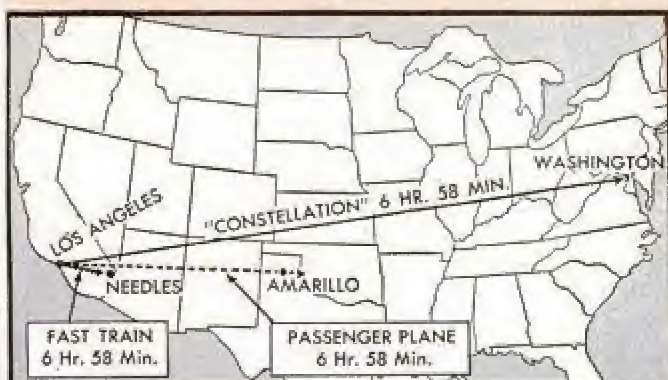
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COMMERCIAL CAPACITY, 57 PASSENGERS
AND CREW; MILITARY CAPACITY, 100 SOL-
DIERS WITH PACKS AND RIFLES

USEFUL LOAD
MORE THAN 14 TONS

OVERALL LENGTH—95 FEET

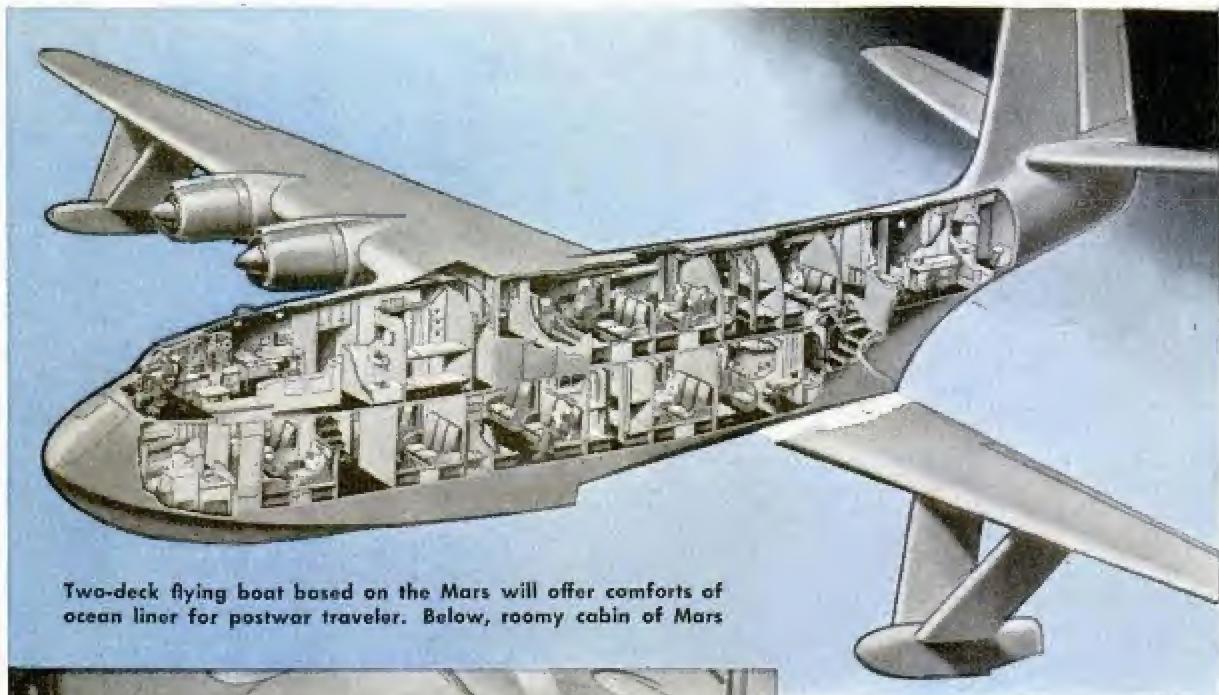


Constellation record for cross-country hop is basis for comparative distances. Right, the powder room on Model 39 mockup

cabins will be pressurized to enable flight in the silky smoothness of the stratosphere "above the weather." Instead of sitting cramped in their seats, passengers will move about with the same freedom they enjoy today on de luxe Pullman trains.

After a lot of big talk about giant transports of weird design that would carry hundreds of passengers at the speed of sound, postwar aviation planners have their feet on the ground and their eyes on actual test flights and planes on order. For example, the above conversation about a trip to Mex-





Two-deck flying boat based on the Mars will offer comforts of ocean liner for postwar traveler. Below, roomy cabin of Mars



The distance covered by the Constellation was somewhere between 2,663 and 2,292 miles, the straight-line distance between Los Angeles and Washington and the great circle route, respectively.

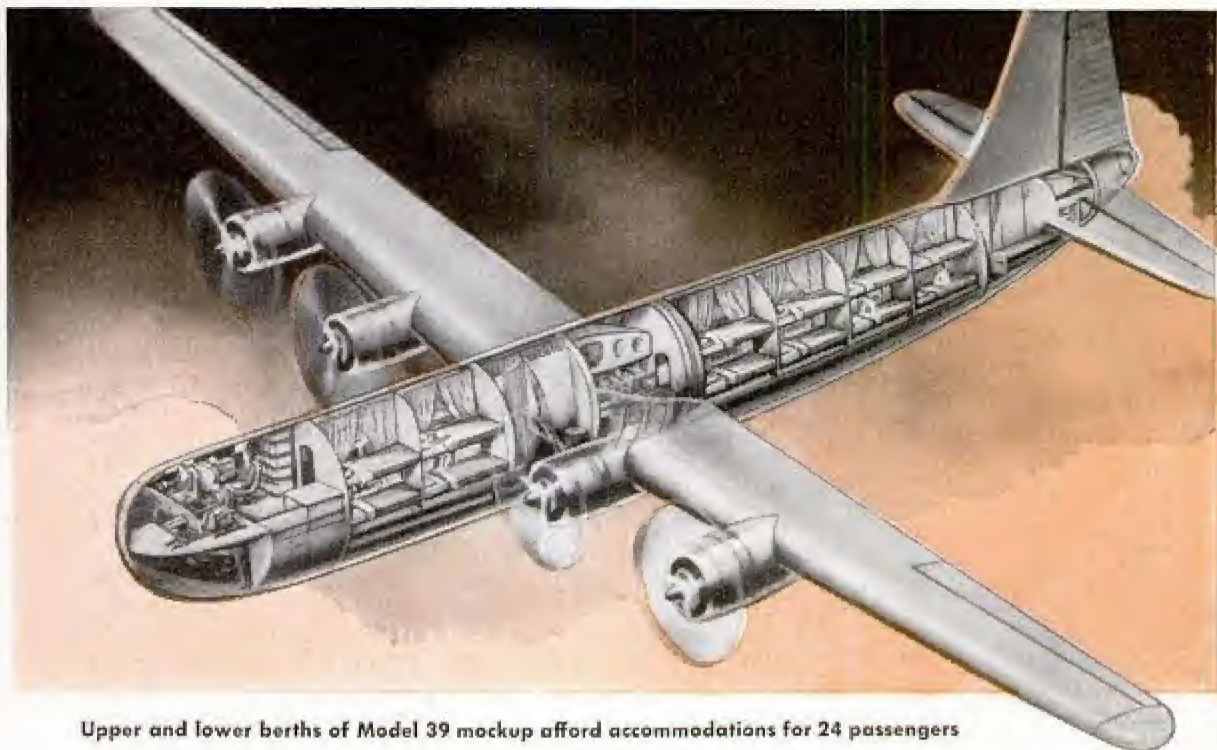
The previous record of seven hours and 28 minutes for a cross-country flight was made by Hughes in 1937 at an average speed of 327 miles an hour. Comparative figures, however, are unfair to the Constellation

ico City in 1948 is based on a schedule of probable world services recently released by Pan American Airways.

A better example is the record-breaking cross-continental flight recently made by Howard Hughes in the Lockheed Constellation, which was designed as a peacetime transport for Transcontinental & Western Air, Inc. This six-hour and 58-minute flight from Burbank, Calif., to Washington, D. C., demonstrated to an air-minded nation that some of the "things to come" in aviation are already here.

The four-motored Constellation with the profile of a shark averaged nearly 355 miles an hour on the trip. Fighter plane speed for a huge transport! A train leaving Burbank at the same time as the Constellation would have been pulling into Cadiz, Calif., when Hughes and his crew were stepping out of the plane at the Washington National Airport. If a regular passenger plane had attempted to race the Constellation, it would have just passed Amarillo, Texas, when the record-breaker crossed the finish line.





Upper and lower berths of Model 39 mockup afford accommodations for 24 passengers

for the earlier flight was made in a small specially built plane with Hughes as the sole passenger. On its record trip, the Constellation carried 17 passengers and had room for 57 if fitted as a luxury liner, or 100 soldiers as a troop transport.

Although the Constellation was flown from Burbank to Washington at heights ranging from 15,000 to 19,000 feet, its perfect circle fuselage is built to accommodate a pressure cabin which will lift its ceiling for postwar passenger flights to between 25,000 and 30,000 feet. With only three of its 2,200-horsepower air cooled Wright engines, the ship can hold an altitude of 25,000

feet, and its ceiling with two engines is 16,500 feet. Two-speed gear-driven superchargers begin operating as soon as the plane leaves the ground, instead of at the 8,000-foot level as in earlier transports.

The Constellation is one answer to the question of size for postwar transports. The wing span is 123 feet—just three feet longer than the first flight made by the Wright brothers at Kitty Hawk in 1903. The plane is 95 feet long. (The familiar 21-passenger DC-3 has a wing spread of 95 feet and is 64½ feet long.) Gross weight of the Constellation is 40 tons, and it can carry a payload of 28,000 pounds.

Lined up before the Constellation are crew and number of passengers—57—it will carry after the war
Courtesy TWA





Courtesy Consolidated Vultee Aircraft Corp.

Seats on mockup of postwar airliner are converted into roomy lower berth

Despite its size, the ship's powerful engines can lift it into the air in less than 1,500 feet at sea level. This, coupled with a landing speed of 80 miles an hour, enables it to take off and land on exceedingly short runways. Maneuvering flaps, which are telescoped into the wing for speed, are extended to increase the lift on take-offs

and for landings at slow speed. These telescoping flaps are one of the reasons for the plane's ability to fly faster, farther, and with bigger loads than any other land transport in mass production.

Civilians will have to wait until the war ends to ride the Constellations, for until then they will be carrying troops and supplies for the Army to the far corners of the world. The official Army designation for the ship that has made those far corners only 24 hours away is "C-69."

Another postwar airliner about the same size as the Lockheed Constellation is the Consolidated Vultee Corporation's "Model 39." This plane is now in the test flight

stage. Its design incorporates the wing and engines of Consolidated's B-24 Liberator bomber which are attached to a new 90-foot fuselage. The wing span of the four-motored Liberator is 110 feet.

Model 39, called the "club car of the clouds," has original seating arrangements

Continued to page 160



It's a 23-foot, seven-inch climb to the top of the Lockheed Constellation's triple tail

Excursion Boat Goes to War as a Troop Carrier^{0 159}



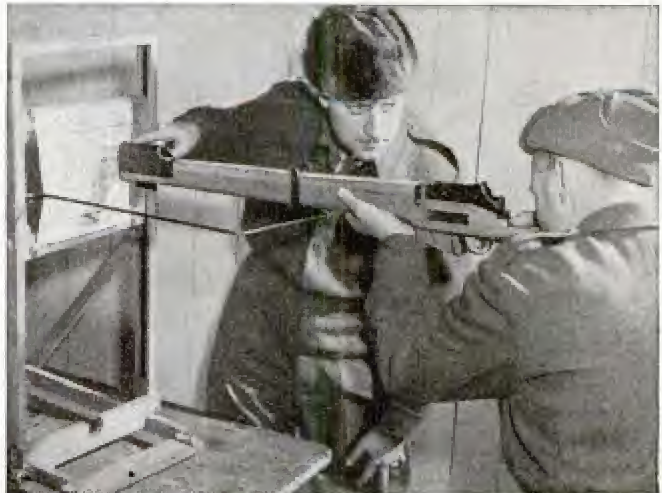
The gray steel-plated sides have streamlined the vessel which began carrying New Yorkers on cruises in 1921

Fitted out with guns and armor, as she was in 1917-18, the De Witt Clinton, a veteran Hudson river excursion steamer, is going to war as a 3,699-ton transport again. Details of her transformation and her new name have been kept secret but officials of the Bethlehem Steel Company, which handled the reconversion operations, said

that a steel superstructure had replaced her wooden decks. Originally named the Manhattan, the 320-foot ship was built in 1913 and purchased by the Navy and re-named the U.S.S. Nopatin in 1917. During the war she took 150,000 soldiers across the English Channel. After the war the Navy sold her to the Hudson River Day line.

Rifle "Fires" Needles One Inch to Chart Trainee's Errors^{0 90}

By using a rifle which shoots needles at a range of one inch, Canadian army instructors can determine a trainee's mistakes in handling a rifle with scientific exactness. The rifle, which looks and feels like an actual gun, is made of wood, springs and pins. Upon pressure against the trigger, it releases a small two-pronged needle rig into a scale model target graph. The upper prong punches a hole where the bullet would normally hit. The lower prong strikes at the same time and shows by its position any faults of canting, elevation or trigger pressure made by the trainee.

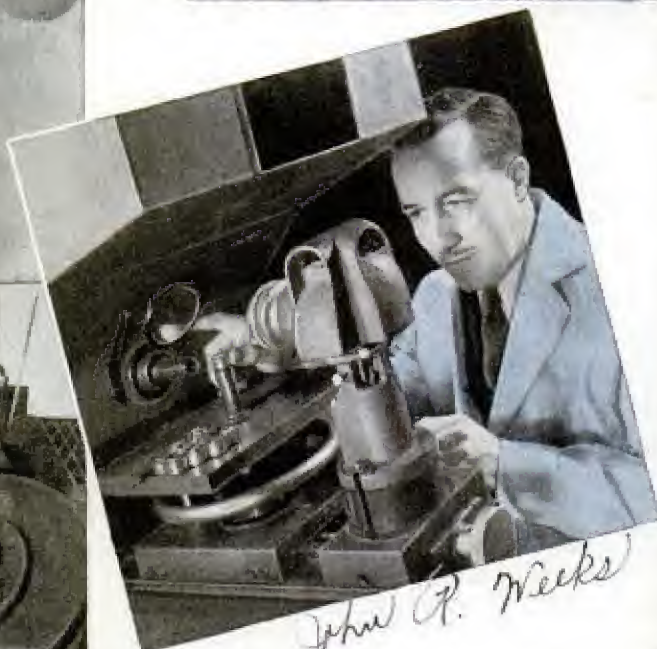


Canadian Army photo

*Curtiss-Wright Corp.
Dayton, Ohio*



Courtesy Curtiss-Wright Corp.
The "G. I. Joe's" of industry are showing ingenuity in discovering ways to increase the flow of war goods. Here are some innovations by workers: above, plastic bell cap center punch which locates the exact center of hole. Right, a polisher for interior of cylinders



Left, foot control for rotary welding fixture was suggested by employee in Fisher Body Division of General Motors; it frees hands. Above, Westinghouse engineer with speedup optical system for inspection unit

HIT the JACKPOT



Theodore D. Caglinger

Curtiss-Wright Corp.
This non-slip bracket for mushroom rivet sets prevents damage to airplane "skin"

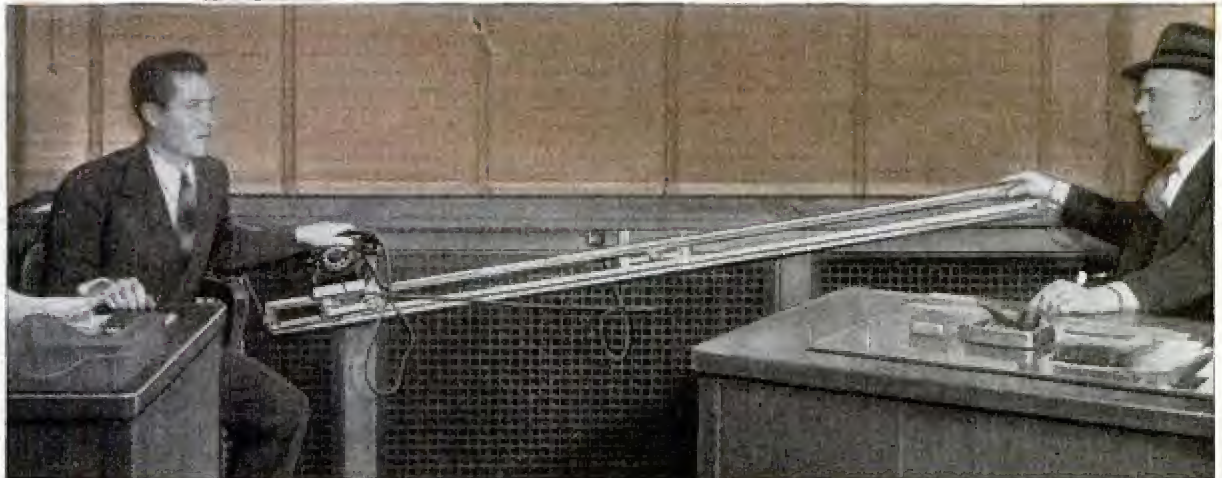


Tire mounting machine suggested by a Goodyear Tire & Rubber Co. employee saves 10,000 man hours a year on airplane maintenance. Roller-pressure principle with long lever simplifies operation and eliminates possibility of damage. This idea was released to the ordnance department. Inset shows old method



Bench clamp that requires no screws or bolts holds work rigidly and is easily removed when not needed. It was invented by a Bureau of Reclamation employee

Below, telephone on wheels slides along rail which is pivoted in center to serve two desks. It was invented by two Chevrolet officials to meet shortage



B-25 Cannon Carrier Mounts 14 Machine Guns



America's twin-engined triple-threat bomber—the strafing, bombing and cannonading B-25 Mitchell—has 10 additional .50-caliber machine guns in its newest model, boosting the total to 14. This array of firepower in addition to the ship's famous 75-mm. nose cannon makes the B-25 the heaviest armed bomber in the world, according to its manufacturers, North American Aviation, Inc. Four machine guns protrude from the nose of the plane, and four others are fixed in a forward firing position, two on either side of the fuselage. Two waist guns and a pair of tail guns can be fired through a wide arc above or below or to the side. The tail turret which has been moved forward from the center of the fuselage is new. There are also two machine guns in the relocated upper turret which has been moved forward from the center of the fuselage. Another new B-25 has only 12 machine guns, its conventional transparent nose containing a bombardier's compartment and two guns. The 14-gun model has a metal nose. The 75-mm. cannon was re-



Top, the 12-gun "Mitchell" with transparent nose; below, the deadly prow of the 14-gun model has eight "fifties" and a "75"

vealed recently to be a full-length field piece that fires about the same size shell as the 75's on Sherman tanks. Both models carry heavier armor than previous types.

Don't Waste Paper!

One of the simplest forms of patriotism you can practice is to save paper. Never in the world has there been so enormous a demand for paper and paperboard as today. Millions of tons of supplies are shipped every month to our armies and naval bases overseas, and a great proportion of the supplies must be packaged in heavy

paper boxes. You can help to ease a critical paper shortage by bundling your waste newspapers, magazines, cartons—even your old letters and greeting cards—and calling the local salvage committee, your favorite charity or any waste-paper dealer to pick them up.

DON'T BURN PAPER! SAVE IT!

1 truck made by

*Mack International Motor Truck Corp.
Empire State Bldg., 27.28.1, N.Y.*

71 861

Trucks Haul Plane and Tower to Set Records

Two six-wheel Mack trucks down in Texas are carrying a couple of blue ribbons on their hoods for hauling the highest, widest and longest loads ever shipped over Texas highways. Highest and widest honors were combined in a single haul when the fuselage of a 21-passenger DC-3 transport plane was moved from Houston to Dallas. It measured 21 feet high and 24 feet wide. On narrow bridges the plane's wing sections were lifted above the railings by means of tandem gin poles mounted on the trucks. One of the trucks holds the record for the longest load—a 115-foot petroleum tower that weighed 80,000 pounds.



Rigging lifted fuselage at narrow bridges; below, 115-foot oil tower

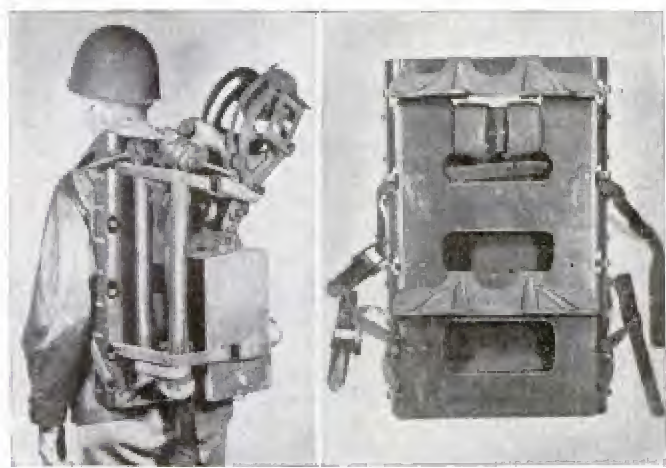


*Hauling done by:
Hunsaker Motor Freight
Lines, Inc.
Dallas, Texas*

Plywood Back Pack for Soldier Makes the Load Easier

To reduce straining and chafing of shoulder and back muscles, an improved "pack-board" has been devised for the American doughboy, to carry awkward equipment

through jungle, mud or snow. The new packboard, weighing only four pounds in comparison to seven for the old style equipment, is made of plywood molded with synthetic resin glue under heat and pressure. Canvas lashed across a recess in the board cushions the carrier's back and protects it from galling and strain. The pack, carried by a shoulder harness, is used by infantry, medical corps, engineers, and signal corps for moving weapons, ammunition, radios, cans of water and gasoline, ration boxes, medical supplies, and stores beyond the point where wheeled vehicles can go.



The light packboard permits soldiers to carry all types of awkward equipment easily. Its cotton shoulder harness can be slung or unslung quickly

REVOLUTION ON RAILS



New York Central tunnel (left) near Peekskill, N. Y., was enlarged to accommodate huge war shipments. Above, inside cab of a Pennsylvania R.R. locomotive showing position light signals

wood trains drawn by Diesel-electric or gas turbine locomotives, beating 100 miles an hour and steadied by gyrostabilizers so that a night's sleep or a day's relaxation will be jerkless and joltless.

New steel and aluminum alloy freight cars—500,000 will be needed—will be as strong as present cars, but several thousand pounds lighter, enabling the postwar freight train to knock off an 80-mile-an-hour clip.

The great postwar changes depend upon the manner in which the railroads can use the increased production of aluminum, steel, copper, Diesel engines, turbines, electric drives, rubber, oil and plastics.

Right now, the railroads are emphasizing wartime efficiency and safety, using the limited materials available, but bolstering them with ingenuity and scientific investi-

OVER the hump in their tremendous job of moving the nation's men, machines and merchandise to their war tasks, the railroads are making the nation's 65,000,000 tons of rails in 400,000 miles of steel road sing sweetly as they roll along toward the greatest period of progress in the history of the iron horse.

Most of the people now alive will live to see railroads so different that some of the equipment now operating will be ready for the museums, many railroad men believe.

For the postwar period, they predict aluminum, stainless steel, plastics and ply-



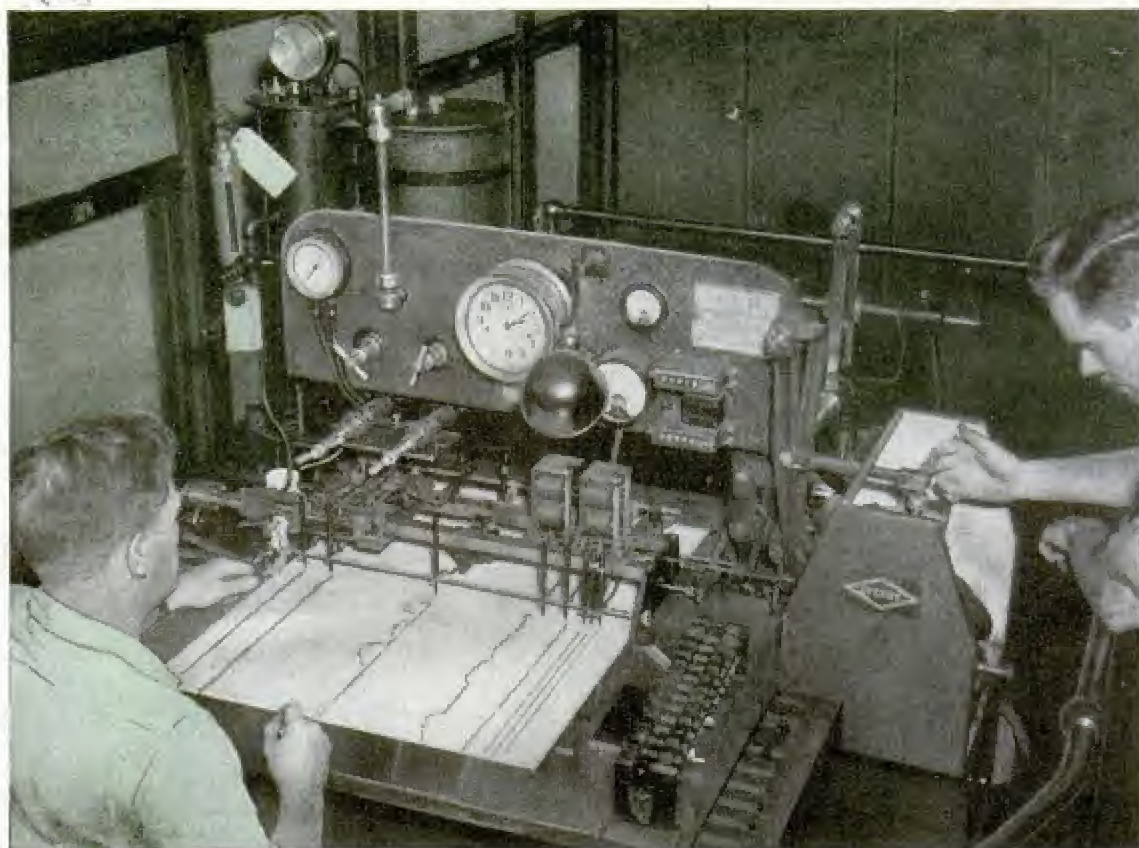
The streamlined "Empire State Express" carries a full load these days on New York Central

gation to maintain safe trackage, millions of miles of wire on 4,250,000 telegraph poles, 1,275,000,000 crossties, the 1,500 tunnels and the 230,000 grade crossings. One of the innovations is a new hollow axle weighing less and providing more strength than the solid axles in use since the beginning of railroading. This is saving 65 tons of steel a day or more than 20,000 tons of steel a year, enough to build 722 General Sherman tanks.

A new plant at the works of the Pittsburgh Steel Company at Alenport, Pa. produces 500 railroad axles a day.

Oiling a Long Island railroad engine; women help on jobs that were once "for men only"





Watching the graph of rail conditions as track recorder car of Chesapeake & Ohio makes an inspection trip

Each axle for a 50-ton freight car, the type most generally in use, weighs 260 pounds less than its solid steel predecessor. With four axles being used for each car, this means a saving in weight of 1,040 pounds for each car. The raw material for the axles consists of forged seamless steel tubing.

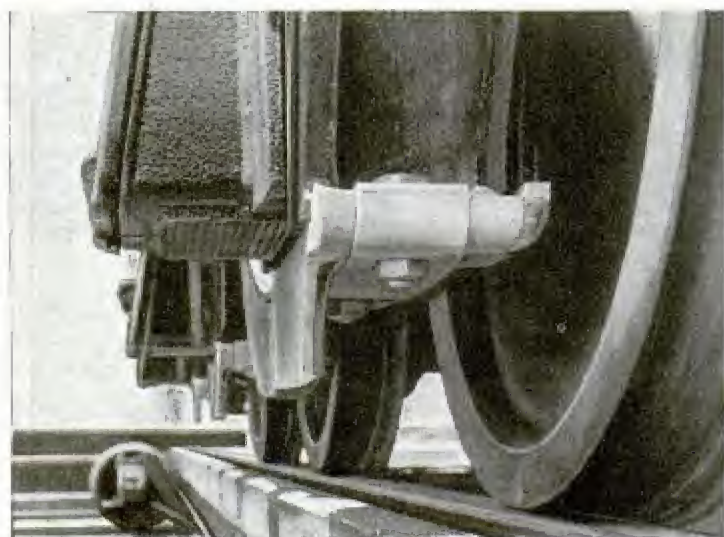
Another example of the progressive trend is the 1,200 triple-deck-berth troop sleeping cars, the first cars in the history of the nation built exclusively for troop-carrying purposes, constructed by the

Pullman-Standard Car Manufacturing Company. War-emergency cars now, they foreshadow the lighter, more compact postwar sleeping car.

Each car accommodates thirty men. The arrangement of berths will be incorporated in one of the new types of cars the company expects to introduce on a wide scale after the war.

In daytime the cars have somewhat the appearance of European coaches. The wide triple-berth seats are grouped in sections on one side of the car with the aisle running along the other side. At night, the backs of the seats are raised to form the middle berth while the seat remains in position to form the lower berth. Upper berths are fixed and may be used at any time. Each section is equipped with racks for weapons.

The question of lightness and strength in railroad cars is being decided in a remarkable "squeeze" machine under the supervision of the Association of American Railroads.



Safety guide on Southern Pacific car lets truck slide on rail if a wheel leaves the track, prevents turning off



Norfolk & Western R.R. photos

Photos dramatize violation of safety rules, warn men to stand near center of moving car. New crossing sign has wigwag, bell and flashing lights

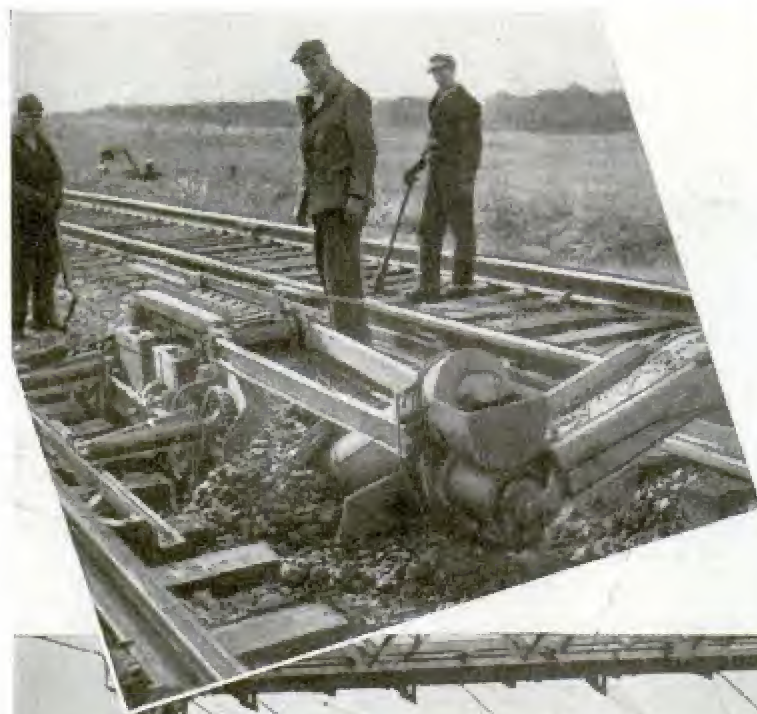
This exerts up to a million pounds of pressure by hydraulic jacks. In other tests for the same purpose—of balancing weight against strength—railroad cars have been sent crashing into each other.

The use of block signals, centralized traffic control and cab signals to accelerate heavy traffic with safety is being expanded.

Centralized traffic control, through which all train movements on a given stretch of track are controlled by one man who throws the switches and sets the signals from a central control desk, eliminates the written train order. Instead, the train crews obey signals displayed at the point where the order would ordinarily be issued.

The cab signal device brings into the cab, before the eyes of the engineman and fireman, the wayside signal indi-





handling of train orders. Carrier current apparatus superimposed on existing wires permits two, and in some cases four or more, telegraph messages or telephone conversations to be accommodated simultaneously on a single wire.

Among the recent developments in the field of electricity and electronics utilized by the railroads are radio-telegraph tugboat dispatching, telephone announcing systems in yards and stations, and yard engine telephone systems.

Left, cleaning ballast on Bessemer & Lake Erie R.R.; 5,000-horsepower electric giant below hauls New Haven freight at passenger-train speed



cation for the block in which the train is operating. The engine crew is also warned by a whistle when a restrictive signal is displayed.

The great increase in wartime railroad traffic and the necessity for handling the numerous details of operation on a minute-to-minute basis have brought an unprecedented load on the telegraph and telephone communication facilities. In many instances Morse telegraph has been replaced by printing telegraph service, thus increasing the message capacity of existing line circuits. Telephone train dispatching, to replace Morse telegraph, has expedited the

Each of the more than 42,600 locomotives and 2,000,000 freight cars and 38,000 passenger, baggage, mail and express cars is carefully inspected by trained, experienced inspectors after each run. Couplers, brake systems, wheels, axles, and all the other moving parts are examined carefully. Wheel journals are inspected and lubricated as required before each trip.

While trains are moving, their condition is constantly watched by all railroad men along the way. Towermen, bridge tenders, crossing gate tenders, crews of passing trains, track workers, and others watch each passing train to report anything out

of order. The crew exercises a careful watch over its own train as well, observing it on every curve. Freight trains are passed slowly over inspection pits, so that their entire under side may be examined by inspectors.

Robert Selph Henry, of the Association of American Railroads, reports that between one and two million tons of rails, enough to lay about 10,000 miles of track, are replaced each ordinary year.

The Pennsylvania Railroad and several others have installed dragging equipment

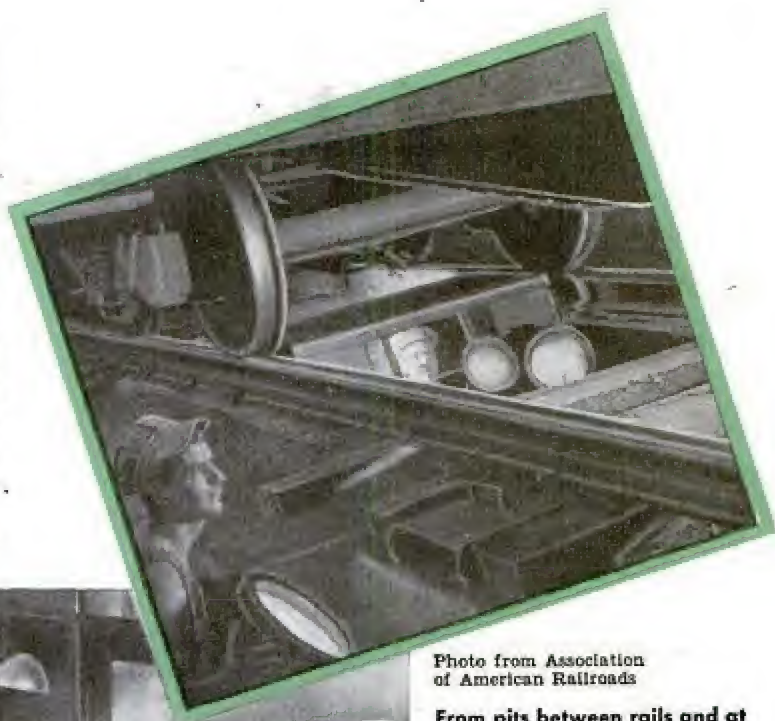
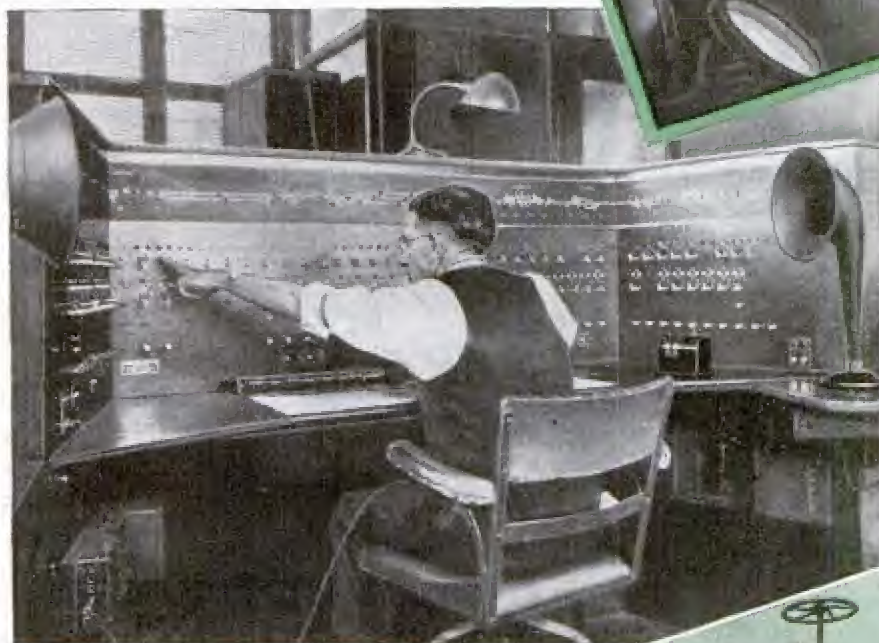


Photo from Association of American Railroads

From pits between rails and at side of track inspectors examine Pennsylvania freight cars



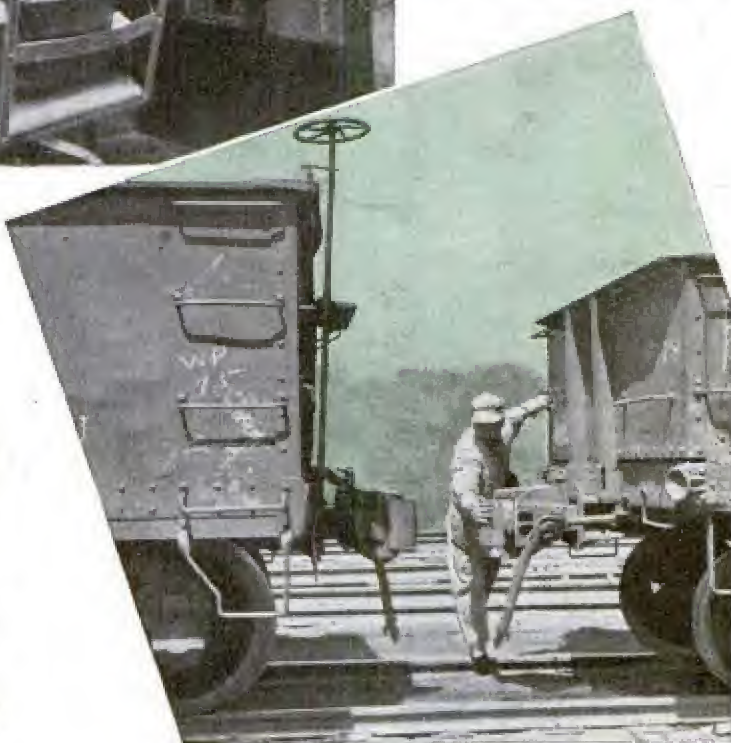
One man exercises "remote control" over miles of track from Centralized Traffic Control board of Baltimore & Ohio

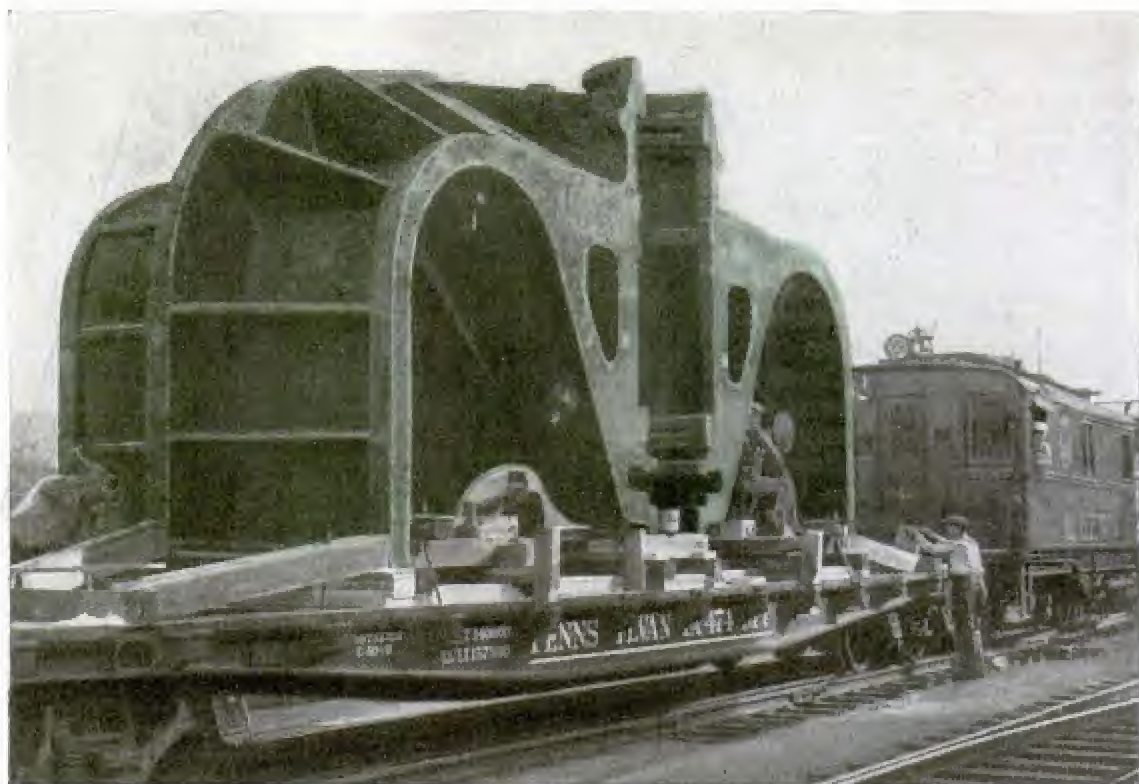
Waiting too long to adjust a coupler may cost a hand, Norfolk & Western photo warns

Union Switch & Signal Co.

detectors at some distance ahead of interlocking switch installations where trains are switched from track to track, for the purpose of indicating the presence of any object which might be hanging from the cars between the rails, and lower than the rail surface. When a train actuates such a detector, signals are set to stop the train before it can pass over the switches.

Another improvement is high speed air brake equipment. In developing high speed passenger trains, and especially streamlined trains, the railroads and air brake manufacturers cooperated in





Typical of wartime railway loads is this 130,400-pound turbine base cast at Westinghouse Trafford foundry

the production of improved air brakes which insure better control of trains at all times and make it possible to bring them to a stop from high speeds within a reasonable distance. One feature of these brake systems is graduated pressure, with the maximum pressure at the beginning of the brake application and subsequent reduction to bring the train to a stop without heavy shock.

As train speeds increased, the Association of American Railroads developed an improved passenger car axle. Beginning with preliminary tests of small axles made to one-quarter size, the research progressed to the building of machines to test full sized railroad axles. With this equipment, installed in a special building at the plant of the Timken Roller Bearing Company at Canton, Ohio, high speed tests on axles of various designs and materials were carried out on a 24-hour basis for approximately two years. As a result, the Association adopted designs for new axles which have greatly increased resistance to fatigue failure due to high speed operation.

Among the improvements in signal protection for trains are "coded" track circuits which require no wires alongside the track to carry current and which can be adapted to indicate a great variety of track conditions. The coded track circuit offers a

higher degree of protection against broken rails than it is possible to obtain with the conventional non-coded direct current track circuit.

Mountain railroads are guarding their lines against slides and rock falls by fences so arranged that if they should be blocked or disturbed by a fall of rock, signals on either side of the fall would give warning.



Santa Fe switchman shows safe way to release hand brake, feet braced and one hand gripping car ladder

Electrical interlocking is being substituted on most roads for the former mechanical method of interlocking. By throwing a lever or pushing a button an entire route is set up for a movement through the maze of tracks and switches in a terminal, automatically interlocked so that no other conflicting route can be set up at the same time. With all the improvements in automatic safety equipment, there is increasing emphasis on the education of all employees in safe practices and safe thinking.

Special wartime jobs have been found for the "porcupine" cars, equipped with rods extending like spines in a fan-shaped manner, built to measure tunnel clearances. They are checking these underground and track-side clearances for huge wartime loads of guns, machinery, tanks and other vehicles. In one case a granite tunnel on the Hudson division of the New York Central was widened to permit loads from new war plants to pass through.

Continuous research is being conducted



Electric fence flashes warning if rocks fall on tracks of a mountain line

by the American railroads with special measuring devices installed under sections of track to register performance under actual traffic.

Steel rails are bent, pounded, and sliced in laboratory work supported jointly by the Association of American Railroads and the steel manufacturers. Out of research have come consistently better and stronger rails. Test machines apply far more severe continuous treatment to steel rails than received under actual operating conditions. Wheel loads up to 80,000 pounds may be applied on the rail which is moved back and forth under the test wheel.

From dawn till dark rail detector cars travel the steel roadways seeking out hidden flaws to keep the rails singing a song of safety. These cars seek out one of the greatest track hazards, the internal "transverse fissure" which occurs in rails and can, if permitted to grow unmolested, cause rails to rupture.

However, cooperative research by the railroads and rail manufacturers has eliminated this transverse fissure, which is a fatigue failure in the railhead. It was dis-

Continued to page 156



And here a Santa Fe switchman shows the wrong way to release brake, knocking it loose without holding on

Gunners Patrol English Coast in Miniature Train



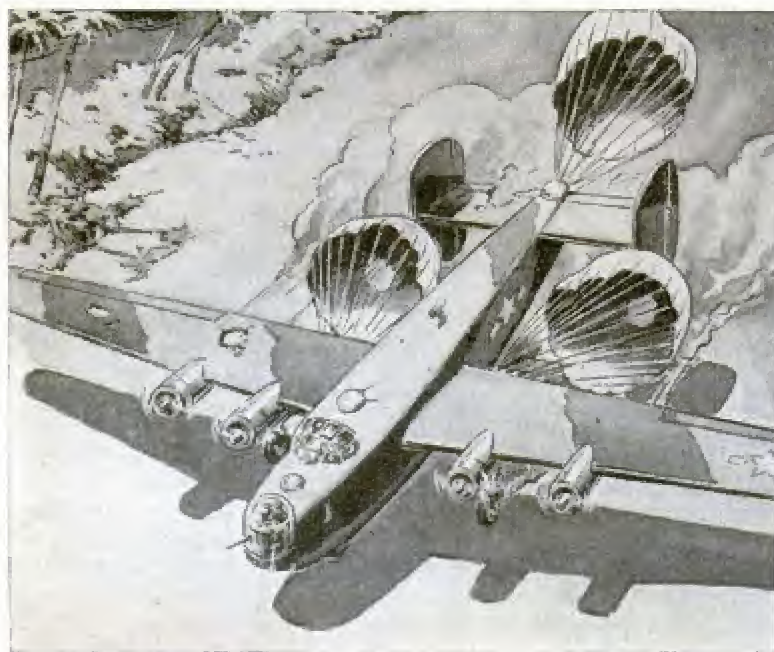
British soldiers are patrolling the Kent coastline on a miniature train formerly used by sight-seeing vacationists. But instead of riding merrily in comfortable pas-

senger cars, the soldiers sit behind grim armor-plate and heavy machine guns, ready to spit death at any enemies who try to set foot on His Majesty's soil.

England

Bomber Uses 'Chutes as Brakes in Emergency Landing

0 205



Parachutes on crippled B-24 reduce landing speed about 40 miles an hour

Quick thinking on the part of the crew and three handy parachutes helped land a crippled B-24 Liberator bomber on a short fighter strip on Tarawa. Jap shells had knocked out the bomber's hydraulic system which made its brakes useless. As a substitute for brakes, parachutes were attached to each of the waist gun mounts and to the fuselage bracings in the tail. The parachutes were released when the wheels touched the coral strip. They opened almost simultaneously, and the crew estimated the plane's landing speed of 140 miles an hour was reduced 30 to 40 miles an hour by the 'chutes.

*Plane piloted by.
1st Lt. Chas. F. Gatter
34 Campbell St., Warren, P.I.*

Huge "Pin-Up Girl" Towers Over Broadway

Crowds at 50th street and Broadway in New York City can't help noticing the world's largest "pin-up girl"—a giant reproduction of an original drawing by the artist, Varga, which decorates the Winter Garden Theater. The figure measures 157 feet long and 30 feet high, and, standing, would tower 12 stories high. If she were alive, she would wear a size 84 shoe. Her lips are wider than an archery bow.

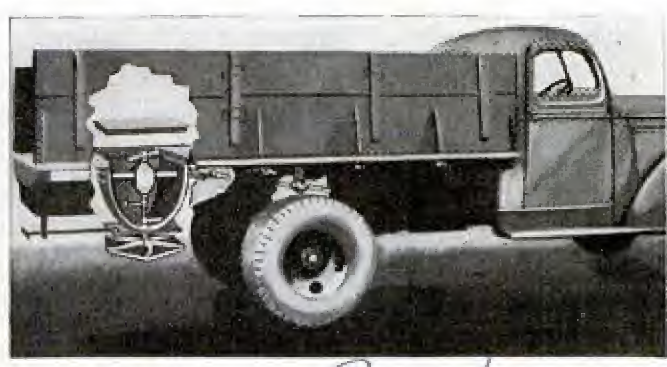
The figure's toes and lips are so huge they make workmen look like Lilliputians



Spreader Unit Installed in Truck Operated by Transmission From Cab

To save labor and simplify spreading of all types of materials on the ground, a spreader is installed as a complete unit under a flat bed truck. It can distribute agri-

cultural limestone, commercial fertilizers, cinders and sand, or broadcast oats and soybeans evenly and uniformly, from 20 to 40 feet wide, depending on the speed of the truck. Power is obtained by a power take-off on the truck transmission. Steel shafts with universal joints run in special bearings to convey the power. Thus, in addition to the driver, who controls the spreader from the cab, only a man to shovel the material into the hopper is needed. A steel plate lid is furnished to cover the hopper so that the truck may be used for other purposes without using the spreader.





FIRST AID for LOST FLYERS

U. S. Army photos

Trainees of Search and Rescue Squadrons show how to lower injured airman from cliff to rubber lifeboat, using saplings and jackets for a litter



doctor, two officer pilots, two forestry paratroop "smoke chasers" and a sergeant. Other units are being formed at Gowen Field and other air fields in mountain areas of the United States.

The training places special emphasis on parachuting over a heavily timbered area, so that rescue personnel may learn to land and disengage themselves when falling directly into trees. For protection against head injuries, the parachutists wear football-type helmets and steel masks like those used by baseball catchers; this equipment is in addition to the usual heavy flying clothing.

Considerable time is given to the art of "spot landing" — bailing out from various altitudes

"EMERGENCY—B-24 enroute from Boise to Wendover—last position reported Twin Falls 0200, last radio contact at 0400, position unknown, somewhere in mountain area—fuel exhausted, must abandon ship."

Many such a terse message barely had time to flash back the predicament of some ill-fated ship before it was forced down to be stranded for weeks in some isolated mountain area.

A group of men have been trained at Gowen Field, Idaho, as the nucleus of a series of units whose purpose will be to rescue flyers forced down in wild mountain country. The first group was composed of a parachuting



and landing as close as possible to a designated marker. The rescuers wear a reserve chute in front for emergencies in which the other chute fails to open.

Army ground personnel are trained in ways of searching for lost flyers, to coordinate with the air search-and-rescue team. The ground men must be experienced in use of skis in rugged country. It is related that once when a bombing plane went down with ten men aboard, 40 rescuers were required, since four men had to be assigned to carry each downed flyer on a stretcher—and it takes about one hour to walk one mile in rough country. Trails must be cut and special equipment used, including a caterpillar-type "snowmobile" which can proceed across deep snow.

The first test of the search-and-rescue units was held in a spot several miles from the training field where a group of soldiers were sent to enact the role of forced-down flyers. These men spread a yellow marker



Top, an Air Force weather observer in arctic. Center, inspecting wind indicator. Below, dog team takes "injured" man to base hospital from first aid tent





Pack dogs are trained to carry emergency aid to flyers downed in Arctic

cloth, a four-foot square which air crews had to spot in order to effect the rescue.

A radio report, purporting to be from the plane forced down, gave the approximate location and the rescue aircraft took up the search. Upon sighting the cloth marker, one pilot brought his plane into the wind and a "drift chute" was tossed out to determine the wind velocity. The drift chute is a 36-inch chute that, tossed free, falls at the same rate as a parachutist. Its use gives parachute jumpers an accurate estimate of how quickly they will land and how near the marker. In this test, three of the small chutes were launched

before one landed close enough to the marker to make it practical for parachutists to follow.

Then one of the 'chutists jumped, landed within 100 feet of the marker and after disengaging himself from his chute, immediately established communication with the plane by means of a "walkie-talkie" radio he carried down with him.

Next, he determined the condition of the men on the ground; finding some required medical attention, he radioed this information to the plane and the doctor parachuted down. Food and supplies were dropped, and an 85-pound medical kit for the doctor.

From that point, the rescue would be accomplished either by a plane carrying stretchers, if the area permitted landing, or by a ski and sled party.

A similar project is under way at another point, in the northeastern states near the Canadian border. It is called the Search and Rescue Division of the Army Air Forces' Air Transport Command. Obviously its job is to rescue flyers forced down on the northern run to England and its operations may carry the rescuers into the frozen lands far north of the United States.

Members of the division are trained in all phases of search and rescue work and

In this actual rescue scene Coast Guardsmen haul an injured man to a hospital after hunting an entire month for six men whose plane crashed into a mountain in an isolated section of Alaska



are ready to speed by plane and dog sled and "shanks' mare" to any remote point where a plane may have come down. While the downed flyers are instructed how to keep alive in the arctic weather, planes drop food and supplies, then medical men if necessary. A large parachute may be dropped for use as a tent to form a shelter from the winds.

Should the flyers be injured or exhausted, members of the rescue teams may jump from planes, administer to the victims and maintain contact by radio with rescuers proceeding to the scene by dog sled or on foot.

Important as these units are to the Army, the real significance of their work lies in the certainty

At right, an emergency hospital tent is pitched to treat patient before attempting to transport him to a base hospital



that the government and the air lines undoubtedly will provide means of rescuing air crews and passengers from desolate lands over which passenger aircraft will fly when peace is a fact.

Left, practicing rescue of men downed on Arctic lake; dogs carry shelters, blankets, food and first aid equipment. Below, men on snowshoes practice with sled



Ingenuity Works Wonders With Scrap

*J. D. Brindley, Major A.C. Creative Officer,
Asst. Chf of Air Staff, Opatone, Comandante's Command*



U. S. Army Air Forces photo
With this crude rigging device, ingenious mechanics of an Air Service Command repair squadron dismantle Jap Zero on the Buna strip. The Zero will be shipped to Port Moresby for use as training ship. Supply and maintenance of U. S. fighting planes on all fronts is the big job of the ASC with headquarters at Patterson Field, Ohio. The ASC has warehouses and depots scattered all over the world. Right, damaged tail of B-17 is speedily repaired with help of extension ladder made of scrap material and attached to jeep. In addition to G. I. mechanics, ASC employs 300,000 civilians



Northwest African ASO photo
Steam boiler for cleaning aircraft parts was made from discarded 50-gallon gasoline drums and scraps of metal "somewhere in North Africa"



Firing oven with homemade torch before baking bread. Eight-foot flame applied for half hour leaves oven so hot it bakes bread in 90 minutes

The IRON CAVALRY



"PETER TREETOP, this is Able Lunchbox. The enemy is pulling out. The enemy is taking the road east of the village. We are attacking."

Able Lunchbox listened to the reply to his radio message, put his earphones away, and stood up in his vehicle.

Up ahead, smoke was rising from fires that the enemy had set. Wary of land mines that might be planted in the dirt road, the scout car and its accompanying tanks moved off across the fields toward the village.

In an earlier war the commander of this little force would have risen in his stirrups, waved a saber, and shouted "Charge!" He and his troop are cavalymen. Today most cavalry soldiers fight from armored vehicles instead of from saddles. They communicate by radio or flags instead of by voice. They groom heavy engines and self-propelled guns instead of horses. But their duties and traditions remain the same.

Theirs is the job of finding the enemy, learning all they can about him,

Scout car commander signaling other armored cavalry units. Below, cavalry troop's antiaircraft machine gun





Driver of self-propelled assault weapon aims a sub-machine gun

and as frequently as not, fighting him. They are the "eyes, ears, and nose" of the army. Field glasses and radio transmitters are their most important tools; the big guns on their vehicles come second. They feel out

the enemy, take prisoners to get information, identify enemy units and their strength, and watch their movements. The cavalry are scouts and spies and fighting men rolled into one.

Aerial observation hasn't taken the place of surface scouting. Ground installations can be camouflaged from air observation but not from a close-up view on the ground. A flying photographer takes a picture of a suspected enemy stronghold and then it's up to the cavalry to verify what the picture suggests. In tanks or scout cars they make a "tactical reconnaissance." Often they get their information the hard way, fighting their way to the objective and back again. Sometimes they are trapped and don't return.

The cavalry were the original commandos, and armored cavalry troops are commando outfits 24 hours a day. Among their multitude of jobs is that of harassing the enemy and breaking through his lines, then running wild in his back area. They blast his supply roads, tear up his phone networks, and shell his supply dumps at point blank range. All the time they are noting details, gathering information, and reporting it by radio.

On the scout cars and other vehicles are short range voice sets for talking back and forth, plus heavy and rugged long range outfits that use dot-and-dash communication.

Slang sentences are often used as or-

Light observation plane, one of the armored cavalry's "eyes," climbs up out of a temporary field



ders, made up ahead of time, to baffle enemy listeners. "Peter Treetop, this is Able Lunchbox. It looks like the old gray mare." Radioed back from a scouting force, the message might mean that the enemy has withdrawn. Or, if such had been decided before the mission began, it could mean that Able Lunchbox had broken down or was disabled.

In such an event it is the duty of the men in the vehicle to destroy the crystal frequency control units of their radio sets. The radio crystals are always destroyed if there is a chance that the enemy might capture them. A set of crystals, captured last week, might be used by the enemy today to issue what seem to be bonafide orders to an American unit. With such crystals the enemy can tune a transmitter to today's frequency and issue orders calling for a withdrawal or a sortie in a useless direction. In the meantime the American cavalry command post, listening in, will break in with a message of denial. The radio operators on the vehicles must use their heads to separate friend from foe on the air. The game works both ways and enemy radio equipment that is captured by us is put to the same use, that of confusing enemy units.

As scouts and commando fighters, the armored cavalry are among the most heavily armed groups in the army. Their specialized vehicles are designed for speed and fire



Radio operator in scout car is equipped with a transmission key clamped to his leg



Scout carries own pack-back radio with antenna he can bend perpendicular. Below, command car covers convoy with smoke by circling it





Above, a closeup of a driver's compartment in a scout car. Below, an armored scout car climbing the bank of a hill. Besides being self-containing for long periods, with their own bedding, food and camouflage nets, these vehicles are among the army's best armed

power. Even the peep-jeep to the rest of the army—is often equipped with a machine gun and becomes a rolling machine gun nest. The big armored scout cars carry heavier armament. There are light tanks that operate with the cavalry and a troop includes several self-propelled assault guns as well, each carrying a machine gun and cannon.

Last year cavalrymen carried revolvers as personal weapons; now many of them have been issued a new light submachine gun that is not much larger than a revolver. It has a heavy wire frame that extends to form a shoulder rest, so the gun can be aimed and used like a rifle.

An armored troop is a self-contained outfit that can operate for long periods with a minimum of supply. The men strap their bedrolls to the outsides of their tanks and self-propelled guns, live off canned rations and whatever fresh food they can capture, and use enemy fuel whenever they can to conserve their own supplies. Each vehicle carries its own camouflage net and each troop has its own pioneer and demolition section. These engineers strengthen bridges, blast trees out of the way, and during a with-



drawal cause as much wreckage as they can to hamper the enemy.

Armored cavalry is at its best in open country; it has not replaced horse cavalry for exploring precipitous and heavily wooded areas. In modern warfare an armored cavalry unit may be assigned to each big infantry unit and to each large armored group. Such outfits are attached to groups that are serving in many parts of the world. Their training is carried on right up to the day of battle even though they were ready and eager for combat on the day they left the United States.

Armored warfare has changed considerably since the Germans first put blitzkrieg tactics into use. Tanks made impressive gains early in the war, then the Russians found a way to stop them. When attacked by tanks the Russians simply opened up and let them through, then concentrated on destroying the weaker supply vehicles that were trying to follow in their wake. The tanks wound up deep in Russian territory, out of fuel. The crews had the choice of surrender or death.

Nowadays tanks are used mainly as the spearhead of an infantry attack. Foot soldiers often ride on the tanks or follow along behind them, and the armored units move ahead slowly enough for their support and

Closeup of smoke pot which produces a dense smoke cloud that lasts for more than five minutes



Under those bedding rolls are driver and commander of tank destroyer. Below, observer and radioman spy from a dead tree



supplies to keep up. In any such combination the armored cavalry plays its part, protecting the flanks or starting a diversion. In case of a withdrawal they remain behind to protect the rear. The cavalry has taken a beating in this war, in Africa and on the continent, yet you will search a long time before you find an iron horse cavalryman who wants quieter duty.

081



Dummies "Bail Out" In Parachute Test

Paratroopers do a lot of jumping out of airplanes but none of them has made as many leaps as the dummies used at the Stanley Switlik parachute plant in Trenton, N. J. The dummies, which correspond in weight to an average man, are strapped into parachutes and dropped from planes as a final test to see that newly made 'chutes are safe. The mechanism that drops the dummies from the plane pulls the ripcord. The plant specializes in "pocket" 'chutes which are smaller, lighter, and claimed to be safer than large ones.

Women pilots strap dummies into 'chutes before taking them "upstairs," where the 'chutes will be given final safety tests

051

Tandem Jeeps Joined by "Magic Link" Double Their Hauling Power

Two jeeps can form a team to haul a disabled 13-ton tank or an artillery piece weighing as much as 4,000 pounds, by means of a "magic link" which hitches them back-to-front as a single pulling unit. The coupling device doubles each jeep's normal capacity to pull 1,900 pounds, enabling

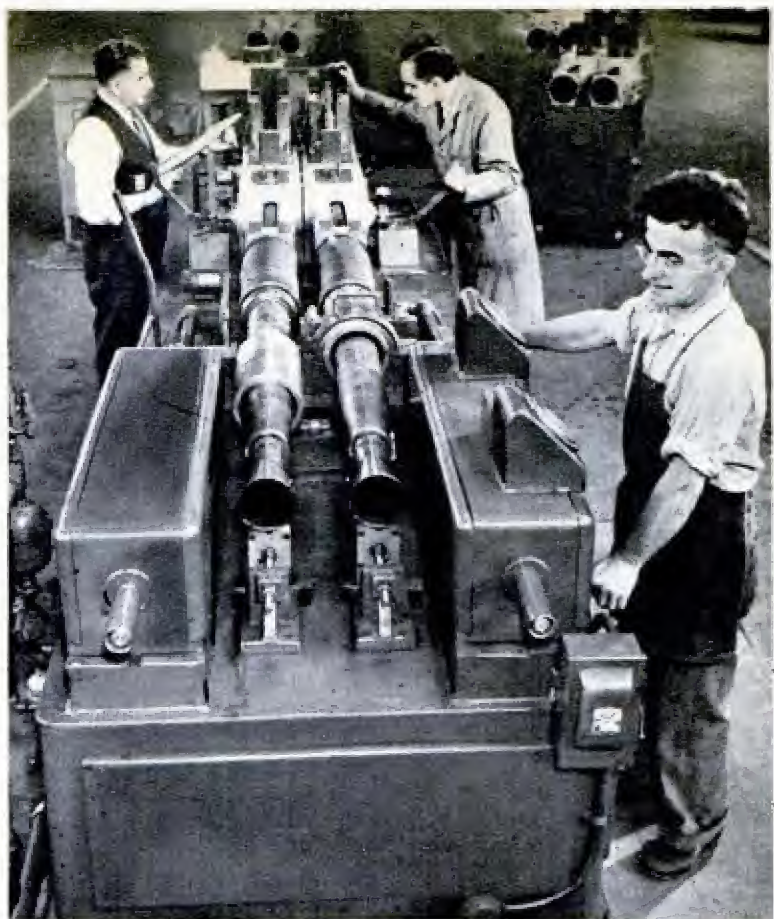
them to pull in tandem a load that ordinarily would have to be moved by 2½ ton trucks. In addition, once they have placed a big gun in position, the scout cars could be unhitched easily and pressed into service at once as reconnaissance vehicles or ammunition carriers.



Willy - Overland Motor, Inc.
Tulsa, Okla.

"Pop Gun" Tester For Flak Weapon Uses Dummy Shell

Forty-millimeter anti-aircraft guns are tested with a machine which uses dummy ammunition and compressed air for power. This machine, developed by the Plymouth Division of the Chrysler Corporation, saves both time and valuable ammunition in testing the complicated mechanism of the gun. Flak is thrown 10,000 feet into the air by this weapon which fires 120 two-pound projectiles per minute. American improvements on the original European design of the 40 mm. gun, along with precision machining of its 1,500 parts, have made possible its mass production.



024
Plymouth Division Chrysler
2680 Woodward Bldg.
Detroit 24, Mich.

Firemen Practice on Tightrope While Balancing Four Reels of Hose

Carrying four reels of fire hose weighing 200 pounds, East London firemen make a 40-foot tightrope crossing to help perfect

their sense of balance. In the commando course at Chigwell they also are obliged to walk a tightrope with ladders slung over their shoulders, cross a rickety wooden structure carrying a length of hose under each arm, and then dive through narrow openings into "burning" dugouts.



Powder Mixed in Water Becomes Fluid Milk

Milk which dairy experts assert looks and tastes just like the fresh fluid variety results from mixing whole milk powder with water. When a dash of cold water is added to four and a half ounces of the whitish powder, which has all the food value of fresh milk, it dissolves instantly into a quart of milk. The powder, which sells at approximately 30 percent under retail prices for fluid milk, could rest on the pantry shelf a year without spoiling. It is made by spraying whole milk into a huge drier into which heated air is forced under pressure. As the milk and hot air meet and fall toward the bottom of the drier, the air takes the water out of the milk.

Consolidated Dairies Corporation
Shawano, Wis.
59

METAL POWDERS SPEED V-DAY

Achievements such as these in the war production program are reported by America's powdered metal industry, and they are not surprising when it is considered that this industry's swift and spectacular development has squeezed 50 years of progress into less than the last 50 months.

Parts and products made from metal powders, some of them almost as soft to the touch as a fine cosmetic, now are used throughout practically the entire range of American mechanized land, air and sea-going fighting equipment, and metallurgists agree they will be very much in evidence in peacetime manufacturing, perhaps revolutionizing many

Left, some of the parts made from powdered metal. Below, hydraulic press for powdered metal, one of largest ever built



FOUR thousand small metal parts turned out to exact dimensions without machining in a single minute.

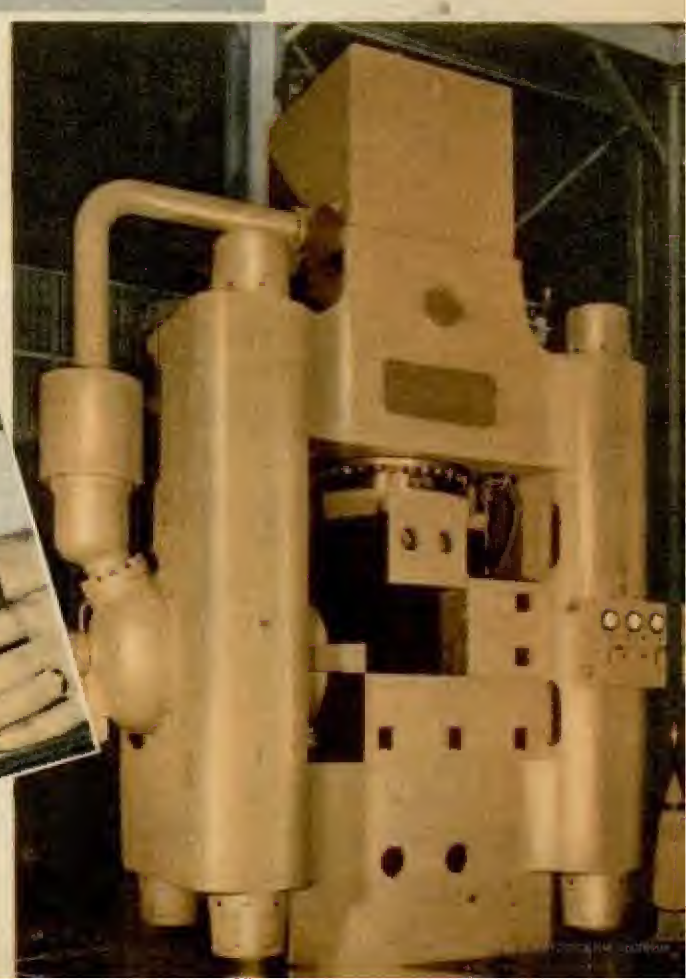
Big gun mount bearings that weigh 60 to 100 pounds, yet require no smelting.

Millions of man-hours of labor, and hundreds of thousands of tons of critical materials saved annually.

New metal alloys hitherto impossible to create by conventional methods.

Below, left, powdered iron is poured into a mold or die; then powder-filled die and plunger are placed between jaws of hydraulic press, right

*Mr. C. H. Moore
1362 N. Dearborn St.
Chicago 10, Ill.*



*Morane Products Div.
General Motors Corp.
Dayton, Ohio*

prewar engineering and production procedures.

Flying Fortresses and B-24 Liberators each are said to have around 2,000 powdered metal parts. B-26 bombers have just under 1,000. Thousands more are used in other warplanes, in warships, tanks, trucks, ordnance equipment and the like, replacing machined parts in most instances. Today you will find electric motor parts, magnets, porous bearings and filters, gears, machine tools, abrasive wheels and disks, diamond drill bits, airplane instrument parts of light metals, brasses and bronzes, camera and clock parts, electrical contact points, and a host of others, made of powdered metal.

The principle of powdered metallurgy, which entirely by-passes the commonly known melting process, is relatively so simple that historians say it even was used by the ancients. It is in the applications of the principle that so much progress has been made since the war began.

Reduced to its elementary steps, making parts from metal powders

Below, weighing oil-impregnated bearing made of powdered metal. It weighs 62½ pounds



"Shot blaster" cleanses welding scale from breech casing for Bofors cannon



Left, above, a pile of metal powder and bronze part it becomes in seconds. Right, magnet illustrates properties of iron powder made of scrap iron



consists of placing the powder in a finely finished die or mold, and applying pressure. This is called "briquetting." Then the parts, which have a high finish but which can be crumbled with the fingers at this stage, are sintered or heat treated in atmospherically controlled furnaces at a point below the melting point. Each part retains its shape and size, but the molecules of the metal particles become fused together or interlinked under



Above, filling steel dies with powdered metal "mix" in the first briquetting operation. Below, lifting oil-impregnated powdered-metal bearings out of bath to drain excess oil back into the tank



heat and the desired strength thus is obtained. Occasionally, it is necessary to do some machining or to apply additional pressure, depending on the closeness of allowed tolerances, or other facts. In most cases, however, parts are ready for use after sintering, and are extremely accurate.

Contributing more than anything else to the growth of the powdered metal industry have been the development of new high pressures, new methods of producing large bearings and other parts, improved die-making techniques, and more scientific mixing of various metal powders to form desired alloys.

Prior to 1940, the heaviest powdered metal part rarely exceeded three pounds; today, bearings of powdered metal range up to 60 pounds and even higher, with diameters up to 30 inches. Designed and probably now in production are bearings weighing 100 pounds.

Accuracy of powdered metal dies and molds has been improved to a remarkable extent, and far more shapes and sizes now are possible than ever before. Making dies for gears has been reduced to an exact science, which explains why most powdered metal parts are so precise when they come from the sintering furnace.

The problems formerly encountered in the often complex tasks of mixing various metal powders to form alloys also have been largely overcome in the last three years. Formerly, ordinary mixing methods would not serve, since powders of heavy metals would not mix evenly with those of light metals, and certain powders would show inability to cohere.

Now it has been determined that the shape of the particles of powders has an essential bearing on how well they will stick together. Circular shapes are rarely used today, except for filters, and shapes may be angular, acicular, nodular or of other oddly assorted contours, each type serving its purpose in a certain form or for a certain article.

There are three principal methods of powdering metal now in widespread use. One is atomization, a process of liquefying and spraying under pressure, used with lead, tin, aluminum and oth-

ers with relatively low melting points. Another is reduction, the removal of oxygen, and the third is electrolysis, or decomposition by electrical means.

Making parts from metal powders eliminates some 20 machining operations, including turning, facing, drilling, boring, counterboring, milling, broaching, profiling, shaping, gear cutting, slotting, grinding, hobbing, chamfering, blanking, flattening, coining and burring. The average machining loss with standard manufacturing methods is said to vary from 20 to 80 percent. But, in making a part from powder, the weight of the powder exactly equals the weight of the finished product.

Strength is another important advantage claimed by powder metallurgists. One manufacturer reports strengths ranging up to 166,000 pounds per square inch.

Powdered metal already has solved many industrial problems, going back to the first industrial application of the process when it was applied to the production of tungsten filaments for electric lamps. Tungsten is the most suitable material for filaments because it will not melt at high temperatures caused by electric current, but this same quality makes it expensive and troublesome to melt and cast. Powdered tungsten provided a way out of this difficulty.

According to P. R. Kalischer, Westinghouse metallurgist, tungsten ore, a coarse brown powder, now is chemically treated to convert it into yellow tungstic acid, also a powder. After refining to remove water and oxygen, pure powder is obtained and this is squeezed to form it into bars two feet long and less than half an inch thick. These are baked in a hydrogen furnace and then placed in hydrogen-filled metal "bottles" while an electric current is passed through them. The material then takes on a metallic appearance, after which the bars are heated and hammered into rods which can be drawn into wires one-fifth the thickness of a human hair.

This material is stronger than the highest grade of steel used in building bridges and skyscrapers. An inch-square bar of tungsten can stand a pull of 250 tons, while the highest grade of structural steel snaps under a load of about 100 tons.

Powdered metallurgy received its most important impetus before the war with the development of "ever-lubricated" bearings. Literally billions of these have been manufactured, and applications have been found in automobiles, airplanes, refrigerators, electric clocks, sewing machines and other common products. Such bearings, being porous, become permanently lubricated after soaking the porous spaces with lubricating oil, and are especially useful in places where bearings are difficult to reach.




Whirling Tower Tests 'Chutes Under Eye of Speed Camera

Because small errors or accidents in the fabrication of parachutes can prove so costly, a parachute manufacturer has developed a test tower and an indoor proving ground to make certain the 'chutes are safe. The test tower, a tripod with an extended cable attached to the released 'chute, mechanically reproduces every stress and strain which the billowing silk might have to undergo in actual use. Every detail of the parachute's operation, from the time it is released, is carefully observed by engineers and recorded by a high speed camera. In the indoor test the 'chute is inspected while radial tension of 20 pounds is applied on each suspension line. Then it is spread over vertical forms shaped to match the inside contours of a 'chute during shock loading, with the suspension lines anchored to the floor. The 'chute is "proof loaded" by applying pressure to a jack and increasing the stages by 500 pounds each until some part of the 'chute gives way.

*Phoenix Parachute Co., Inc.
Manchester, Conn.*

☞ See the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

THEY GET THERE



The time is two a.m., July 9, 1943. The soldiers are glider troops spearheading the invasion of Hitler's Europe. As the big engineless machines streak down on the hostile shore there is a roar of transports overhead. Parachutes blossom in the sky bearing still more attackers. Their objectives, like those of the glider troops, are enemy strong points and roads up which reinforcements can be expected to move to block the Allied landings.

Outside a pillbox a German sentry hears the transports, sees the chutes floating to earth. He dashes frantically to the field telephone but is cut down by the guns of glider commandos. A companion manages to gasp the message: "Troop carrier planes!

By Major Vincent P. Wilber, AC

THROUGH the night sky there comes a low whistling, like the singing of a telephone wire in the wind. Now a vision of great batwings momentarily against the moon, a deep bumping noise and a rumble. Suddenly out of the blackness of a Sicilian meadow near Gela materialize the forms of armed men, their faces blackened, carbines at the ready. The whistle and the shadow come again and again. The troopers multiply, band together into groups and move off into the blackness.

British War Office photo

Paratroops pour out of troop carrier planes in mass descent, above. Gliders carry jeeps and 75-mm. pack howitzers; below, airborne troops unload a big gun



FIRST

Last man to land is still unbuckling chute as comrades begin attack with tommyguns



Hundreds of them Dropping paratroops and gliders on our positions! Send help!"

How well the Troop Carrier Command of the Army Air Forces and the British and American airborne troops they carried did this job is best expressed in this commendation received from General Eisenhower himself: "The record of the performance of the Command has given me great gratification. The accomplishment of its officers and men in carrying to their destination, through difficult weather, navigational obstacles and hostile fire in unarmed and unarmored aircraft the largest number of troops yet lifted by air, is a signal one. Their return to base with a loss of only two percent, and their complete readiness for operation on the following night is remarkable and shows great fortitude, superior organization



Above, a paratrooper is ready to "hit the silk" along with his outfit's famous jumping mascot, "Geronimo." At left, airborne bicycle troops go aboard an air transport



Inside a glider headed for enemy territory, soldiers equipped with tommy guns, rations, water and first aid equipment await action behind enemy lines. Below, glider is airborne before towplane leaves ground



and training on the part of all concerned."

The Troop Carriers received a slightly different commendation from the enemy. According to Nazi and Italian prisoners, their high command was of the opinion that approximately twice the number of troops were descending from the skies than was actually the case, so great was the confusion.

One of the youngest organizations in the Army Air Forces is the I Troop Carrier Command, founded April 30, 1942, with headquarters at Indianapolis. It is the responsibility of this organization to train and send out to

Down in approved fashion, Marine's next move is to spill air from chute



battlefronts the Troop Carrier wings, groups and squadrons which have been eulogized as "the common carriers of death and destruction. . . Destination, the enemy's rear."

An example of the type of courage and skill with which the TCC seeks to imbue its flyers is the saga of a plane piloted the night of the Sicilian operation by Captain James R. Farris.

A few minutes before he reached the drop zone an anti-aircraft shell ripped a huge gash in the fuselage and carried away part of the vertical stabilizer. Capt. Farris continued to his objective, signaled the paratroopers to jump, then turned back for his base in North Africa. Although flying at a speed not far above the stalling point (the co-pilot later reported there was only about half a ship left) Farris managed to make it by skimming just over the waves of the Mediterranean.



The pilot of another damaged aircraft, limping back on one motor, decided to make a belly landing in the water. When he hit, the plane bounced thirty feet into the air, but he managed to get it under control and bring all hands down safely.

The I Troop Carrier Command maintains ten training bases in the United States. A Troop Carrier pilot, just out of flying school, reports first to the command's transition training center, Bergstrom Field, at Austin, Texas. Here he learns to fly the C-47 aircraft, the same plane flown by the nation's commercial transport pilots, most of whom have had hundreds of hours of air time before they can touch it. Inside the C-47 are 24 aluminum bucket seats shaped to fit 24 posteriors in parachutes. An astral dome has been added for use of the navigator in taking sights. Otherwise it is the old, reliable Douglas DC-3. In the combat theaters it is called on to haul loads that would give a CAA inspector in this country the creeps.

From transition training a TCC pilot moves on to unit training where he is assigned to a squadron preparing to go overseas. He now gets a month of practice in navigation, night flying, glider towing and close formation work. This may be at any

Parachutists march aboard planes that will ferry them to scene of action, where they will attack an airport to clear way for airborne infantry following. Below, a C-47 troop carrier converted into ambulance

T/3 Clifford J. Gmeling, Lakewood, Ohio.



Continued to page 150

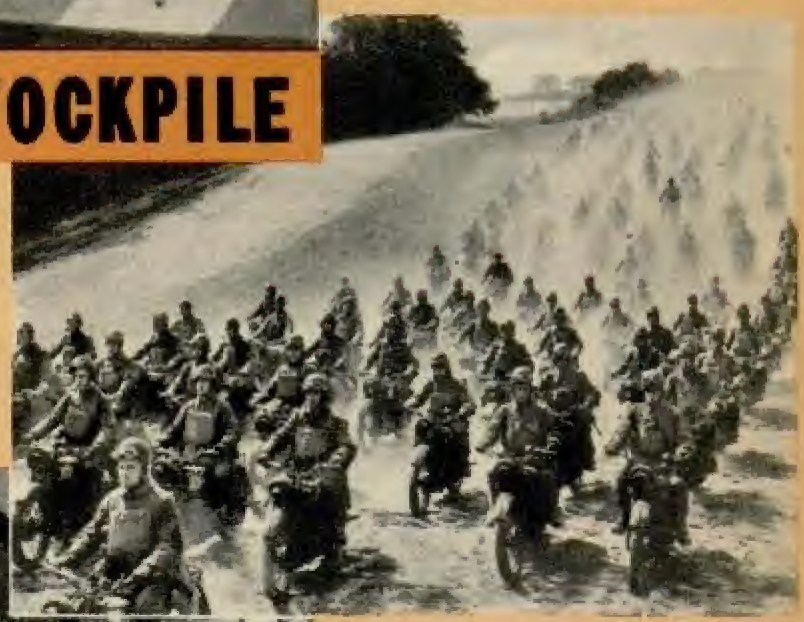


An armorer (above) counts noses in the "bomb bank" before ground crews start loading planes. These went to Hamburg

INVASION STOCKPILE

An avalanche of war materiel from U. S. and British plants has transformed England into an island arsenal to supply the hardest hitting invasion force in history. No roof is big enough to hide the vast array of 25 pounders with tractors above—a field piece with a punch well remembered by the Afrika Korps, and a potent weapon for invasion

See Chicago 1, Ill. 1944



Once it was Nazi Panzer troops that roared across the boundaries of defenseless neutrals. Here Britain's motorcycle army prepares for action



Left, this bombproof shelter houses what it offers protection against—bombs. They are piled up by thousands in underground storehouses ready to be sent to bomber stations

Below, barges packed with decontamination trucks on way to U. S. ships which will carry them to invasion front—just in case Nazis use gas

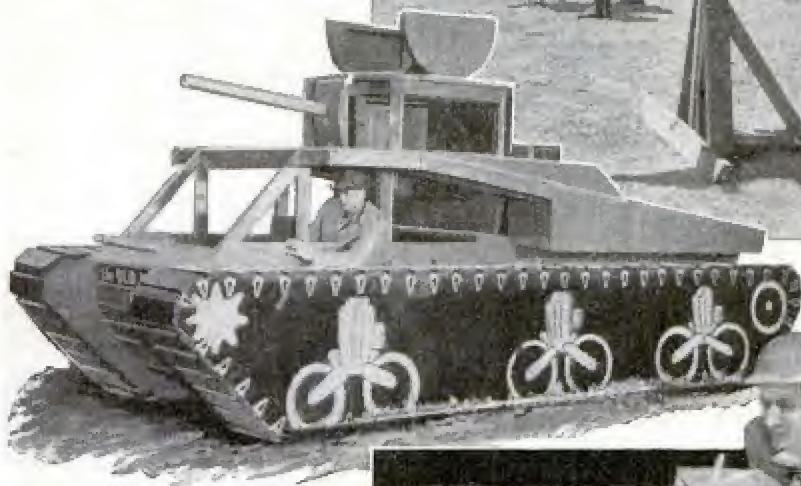


Non-Kicking "Model" Mule Helps Train Yanks

What do they do in the cavalry? Well, before they ride the men must learn the art of tying and packing equipment carried on horses and mules. The proper method of bridling, saddling and packing is taught at Camp Funston, Kas., with wooden and kick-proof mules (right). It takes skill to balance pack



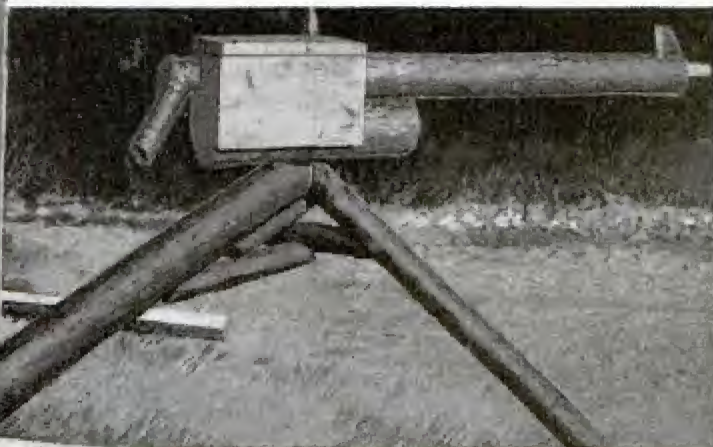
Signal Corps photos
Wooden machine gun (below) wouldn't stop a Japanazi, but it's a handy weapon to use for "strafing" ridge during maneuvers



This tank, built of lumber from scrap pile at Camp Joseph R. Robinson, Ark., has movable guns and sides which let down. It's for training medical soldiers in removing wounded men from tanks that have been disabled in the field



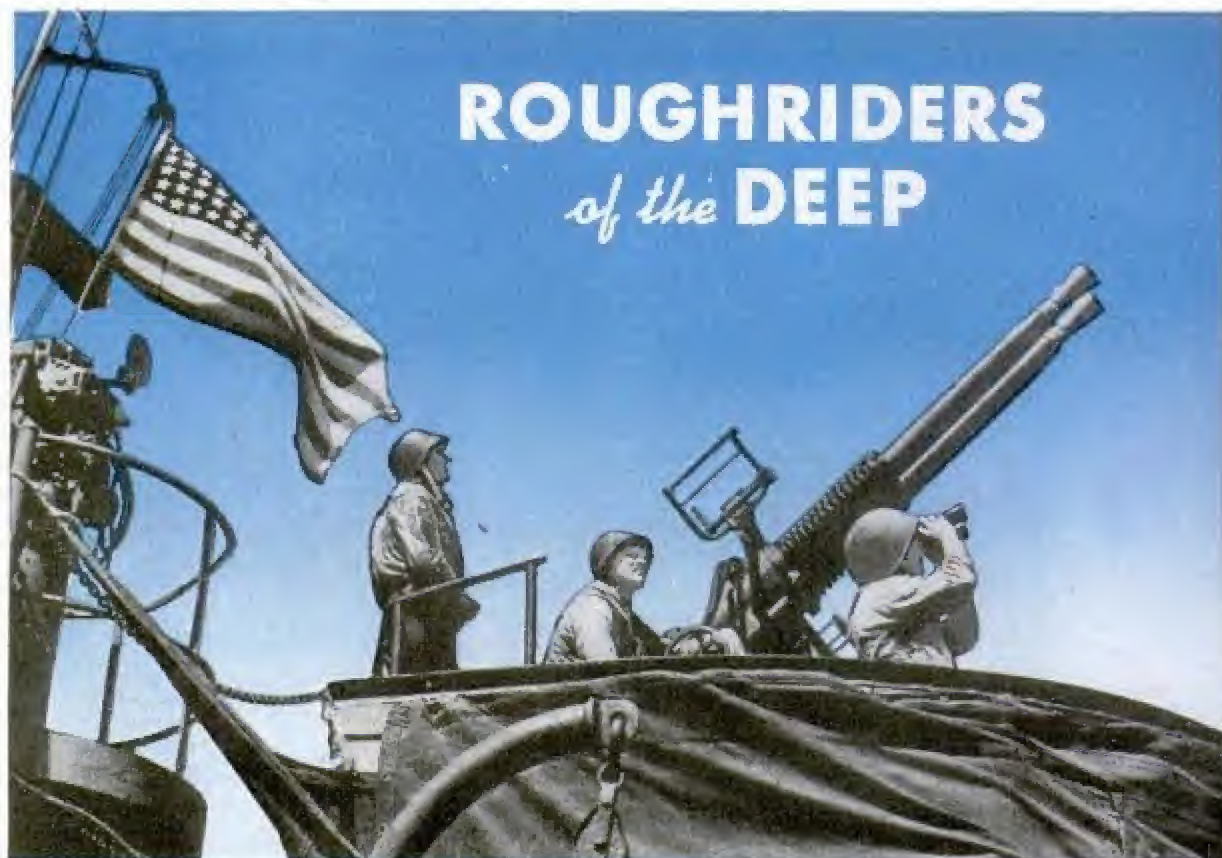
Dummy guns (left and below) were used extensively during field maneuvers before America's war production caught up with its fast-growing army. The men who manned these guns have swapped them for the real thing, but the training they received with these crude models proved of value at places like Guadalcanal, Gela Beach and Attu. Today throughout the world, U. S. soldiers have the finest and most deadly equipment of any army



JULY, 1944

*Douglas Parmentier, Lt. Col., A. S. C. Chief
Publications Branch, Bureau of Public Relations,
War Dept., Washington 25, D. C.*

Mr. Stimson, 3872 Franklin Ave.
Los Angeles 27, Calif.



ROUGHRIDERS *of the* DEEP

Above, ack-ack gun crew aboard a destroyer. Below, lookouts on the flying bridge wearing battle helmets, masks and warm clothes

U. S. Navy photo



By
Thomas E. Stimson, Jr.

YOU take a beating when it's your turn to act as lookout on a destroyer in rough weather.

The biting wind screams through the rigging overhead, it digs through the slits of your foul-weather mask and freezes your face, it picks up spray from the bow and slings it up at you on the flying bridge, 30 feet or more above the water.

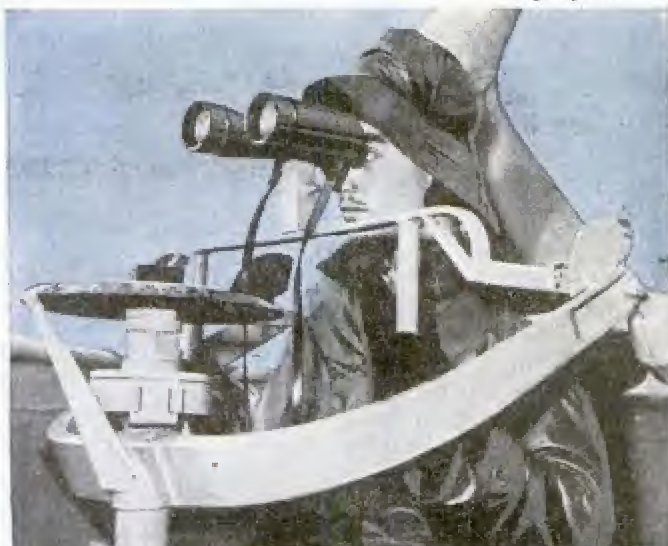
The rolling motion of the ship is accentuated at that height. Possibly you are going to be seasick but not for more than an instant do you relax in your duty of searching your quadrant of horizon and sky for ships and aircraft. You would be warmer and dryer under cover but your eyes and ears are most efficient just where you are, exposed to the weather. Night and day, all the time a destroyer is at sea, four men

are on lookout. They stand two hour watches.

A destroyer is a comfortable vessel in pleasant weather and at moderate speeds but fair weather for cruising can't be picked during war. Big ships plow through heavy swells with hardly a quiver. The "cans," long and light and built for speed, pitch over them instead. They roll, too, at almost all speeds.

Often you strap yourself in your bunk to avoid being thrown out. Part of the time you make your way along deck by means of a life line, hanging on when green water comes aboard. Sometimes you eat with an arm wrapped around a stanchion, holding on to a sandwich and a mug of coffee. A plate of food on the table would tumble into your lap. The sailors who perform technical tasks on a big battleship are sometimes hardly aware that they are at sea. Destroyer men are always in intimate contact with it.

Destroyers are the smallest all-around fighting ships of the fleet and they have a multitude of duties. They screen larger warships, they hunt down and destroy submarines, and they accompany aircraft carriers to help protect them and to rescue airmen from the water. They lay smoke screens to hide ships that have been dis-



Lookout (above), dressed for stormy weather, studies the horizon with powerful binoculars mounted on swivel. Below, signalman wearing polaroid glasses operates blinker



Below, crew of 20 mm. antiaircraft gun rehearses as blimp cruises in the background





Preparing to drop depth charges near submerged enemy submarine from destroyer's stern. Armed Navy blimp stands by

abled. They perform convoy work, engage in patrol operations, use their deck guns to cover amphibious landings, and on occasion serve as small, high speed transports.

Regarded as expendable fighting units, they must be ready to sacrifice themselves unhesitatingly if they can save a larger ship by doing so.



A single heavy shell that lands in an engine room can put a destroyer out of action or sink it. On the other hand, they can sink capital ships that are many times their own size. The traditional role of destroyers in a sea fight is a high speed dash toward the enemy battle line. When they attain striking distance they wheel and launch broadsides of torpedoes from their deck tubes. The torpedoes fan out so that the targets can hardly escape no matter how they maneuver. The United States has hundreds of these deadly craft.

Their speed is their best protection, for they carry practically no armor. Even our newest destroyers that are almost big



enough to be classed as baby cruisers are lightly built. Their thin hulls bend and weave when they smash into big seas. Destroyers have long thin lines, about 10 feet of length for every foot of beam, to help give them speed. Their hulls have room for little more than their great engines, fuel for the engines, and the torpedoes, depth charges, and shells with which they fight.

Not much space remains for comfortable living quarters and during war even some of the

Torpedoes, or "tin fish," being fired from tubes of a destroyer

conveniences of peacetime are removed. The men sleep in bunks that are jammed and crowded three deep in the living spaces. On the other hand, the ship's captain has two bunks, one in his cabin and one adjoining the bridge, yet at sea the captain gets less sleep than any other member of the crew. He sleeps, when he can, wherever he will be handiest for action.

In new destroyers the crews are served chow cafeteria-style and use their mess halls as a recreation room between meals. In the destroyers that were built during the first World War, old but still very valuable fighting ships, the men eat at tables that are placed



Rescue party with life preservers and medical kit go to aid of a shipwrecked sailor. Below, U.S.S. Morris, a medium-sized modern destroyer
U. S. Navy photo



between their rows of bunks. Garbage from the galley is saved and is dumped once every few nights. Garbage that is thrown over the side too frequently might give information to the enemy as to the ship's course.

Sailors like to have and use their own personal radio broadcast receivers but the only such receiver on a warship today is in the main radio control room. Popular programs are received on it and are re-broadcast over the ship's public address system.

The public address system has other uses as well. Announcements and orders are made over it. In earlier wars, men who

Continued to page 158

A damage control detail wields fire fighting lines along the deck of a destroyer



"Turkish Bath" for Bomber Made of Old Boiler

Fourth Air Depot

First glance at a novel aircraft cleaning system used in Australia would convince the visitor that he was looking at a cross between a locomotive and a bomber. The stack belongs to a steam boiler, taken from an old dairy, which is used to produce the steam to clean the plane. All planes arriving at the air depot are given steam baths to remove mud and dust which retards speed of the ships.

Getting steam up in the boiler to coax a coat or two of jungle mud from a bomber somewhere in Australia

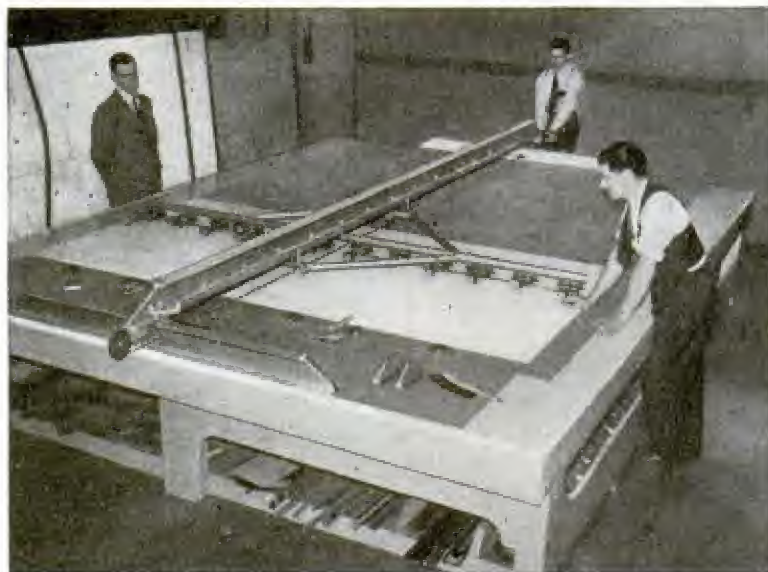


Six Months' Work Done in Day by Huge "Grid Machine"

Work that formerly took half a year now is done better in a single day at the Boeing

Aircraft Co., Seattle, Wash., with a large "grid machine" invented by an employee.

The machine, which draws 12 lines on metal at one time, saves hand drawing and makes the process of drawing straight lines on the painted surface of sheet metal more accurate. The table has a smooth steel top and a simple application of girder members keeps it rigid, allowing a cross piece boom to move across its surface with a gang of scribes which cut the lines. It is easy to slide the plate at right angles, fasten it, and repeat the process to make the grids necessary for master layout drawings.



Fireproof Asbestos Air Ducts on Planes Save Metal and Man Hours

Air ducts for both heat and ventilation on aircraft are made of a fireproof asbestos product that saves aluminum and other metals. The material, made of fabric, as-

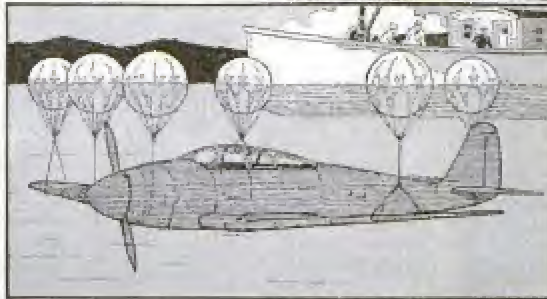
bestos, and a coating of synthetic resin, eliminates welding, die casting, riveting, and intricate metal processing. This pliable fabric can be formed into intricate shapes.

Balloons to Lift Sunken Plane Support 6,000 Pounds Each

Navy engineers plan to salvage airplanes which have been shot down over water with an ingenious use of balloons, each of which can lift 6,000 pounds. The special balloons, developed by Navy engineers and made by the General Tire & Rubber Company, Akron, Ohio, are attached to a sunken plane while deflated. When air is forced into the balloons, they will raise the plane to the surface. Stress on the big balloons is evenly distributed by loops around the middle to which rope or cable is attached. A plane can be towed away easily after it is raised.



The six special balloons shown in drawing can lift 36,000 pounds of airplane to the surface. Balloon in photo could lift five times the number of girls gathered beneath it. Navy engineers developed this plan for salvaging planes

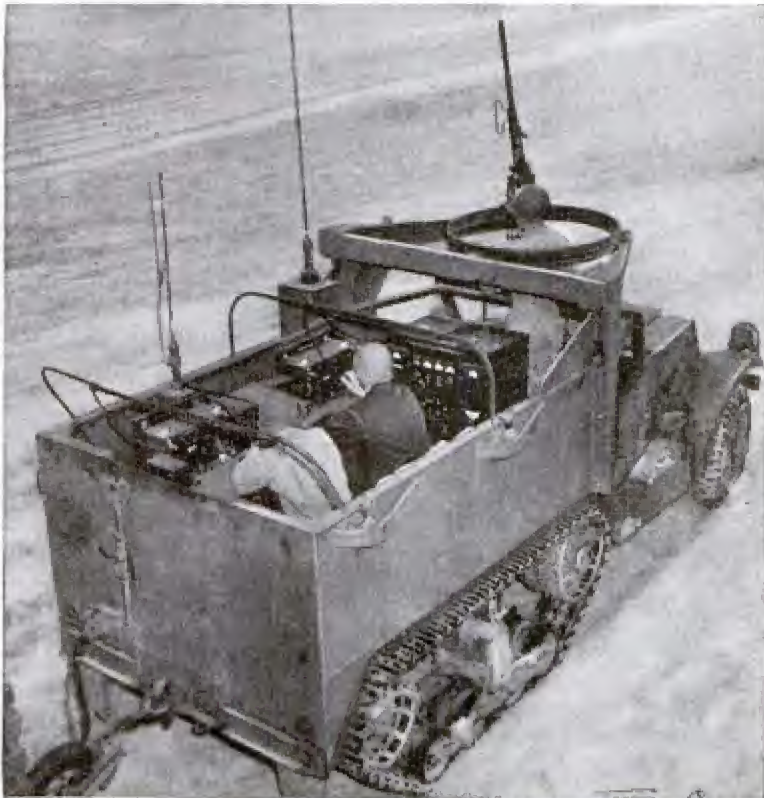


Radio Station Built Into Truck Has Range of 100 Miles

Mounted on a 1½ ton army truck, the Signal Corps' SCR-299 mobile radio station has a range of at least 100 miles day or night using either voice or code transmission and traveling at full speed. The

unit consists of a short-wave transmitter of approximately 450 watts output, two standard receivers, a speech amplifier and a special antenna tuning unit to match the output of the transmitter to a 15-foot whip

antenna. Power is supplied by a gasoline-driven, 117-volt, AC generator carried in a trailer behind the truck. Accessories include two field telephones with a mile of wire, a Signal Corps frequency meter, an electric heater and enough tools and spare parts to perform a major repair job anywhere. Variations of this equipment include the SCR-399 in which the same radio components are mounted in a shelter which can be used on a 2½ ton truck or placed on the ground for fixed station operation, and the special installation in a half-track which is used for air liaison communications. When operated as a fixed station where a large antenna can be used, the range is greatly increased.



The WORLD'S BIGGEST BUSINESS



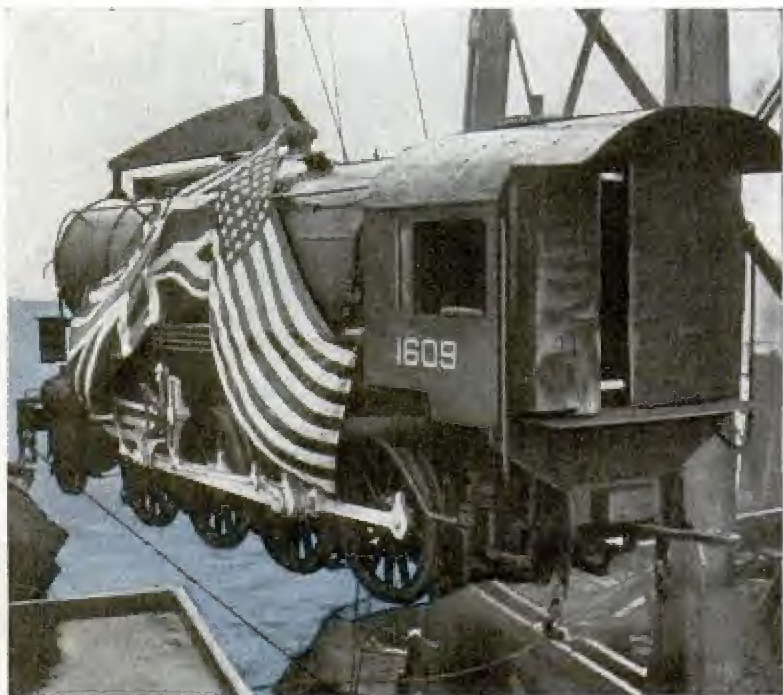
By Roderick M. Grant

The railroads, breaking records day after day, take such loads as this in stride. Below, 130-ton American locomotive lands in England

EPICS happen every week in this war and are forgotten the next.

One of those epics was the incredible trek of the French under General LeClerc a thousand miles across the Libyan desert from Chad to the Mediterranean. They fought a few outposts of Italians holding the oases and freed General Montgomery's army from the threat of flanking as it advanced from El Alamein. More than men, they fought mountains and gales of sand, blistering heat and stark cold. Mostly they fought distance.

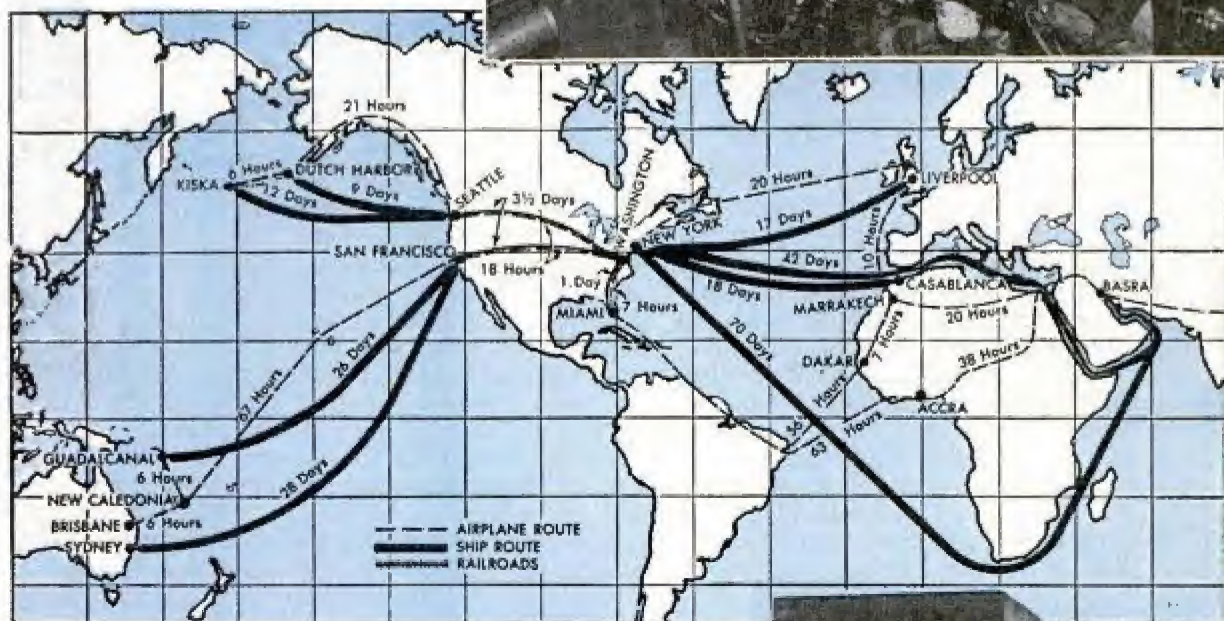
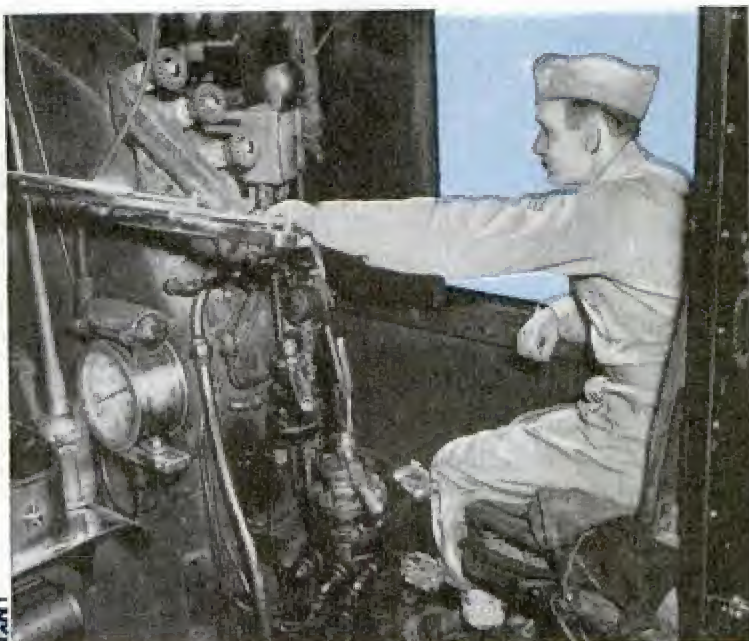
Wading through perpetual dunes, the column of trucks was nourished by Douglas DC-3 planes that flew a thousand miles to bring them fuel and supplies. It cost 20 drums of gasoline to bring a single



drum to the advanced base at Zouar in northern Chad. The planes that flew on 500 miles to supply the column in mid-Sahara burned 11 drums of 100-octane gas to deliver 15 drums of motor truck fuel.

The obliteration of Hamburg was another epic. In one raid alone, Flying Fortresses in 45 minutes dumped over the Nazi port 5,152,000 pounds of explosives, a year's supply to the engineers who blasted the route of the Panama Canal.

Paratroop sergeant at right takes a lesson in running a locomotive
Signal Corps photo



The Alaska Road was another. In February, 1942, Army Engineers got the order to plan a 1,480-mile road through uncharted wilderness. Eight months later the pioneer highway was open.

Each is an epic in itself, and together they point up the immensity of this war of logistics, of supplying armies on every continent; flying fuses from Montreal to Egypt to save Suez, piping gasoline a thousand miles from Skagway to Fairbanks, shipping millions of tons over 56,000 miles of sea routes. The world's biggest business is that of supplying

Map of U. S. Army supply routes contrasts time by ship and plane. Below, army jeep with steel wheels hauls a freight in Australia





The amphibious cargo carrier for landing operations, this "Duck" is hauling a 105-mm. howitzer up the beach

our fighting men. In the first year and a half of war we sent abroad 2,000,000 men, in addition to thousands already overseas. Initial equipment totaled $7\frac{1}{2}$ tons per man. Maintaining that army overseas requires 82 pounds of supplies per man per day—more than a ton every month.

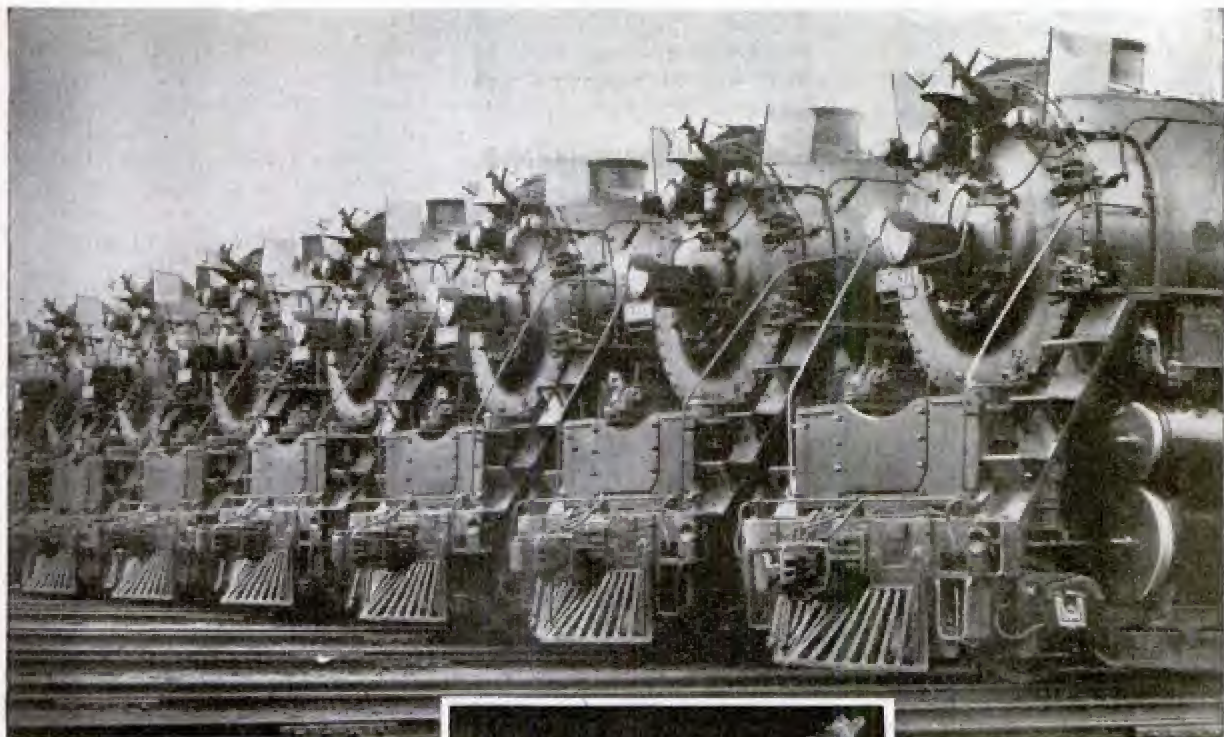
The man who oversees the task of supplying and transporting the army is Lt. Gen. Brehon B. Somervell, commanding general of the Army Service Forces. That he is succeeding remarkably is reflected in the official report of Gen. George C. Marshall, Chief of Staff of the U. S. Army: "We are

equipping the Chinese troops and French troops, we have been providing equipment for the British, Australians, New Zealanders and Canadians, we have furnished supplies to Latin American republics—we have been truly an arsenal of democracy. All this demands the maintenance of an elaborate system for allocation, distribution and transportation, to be coordinated with our daily normal problem of meeting the demands of our own forces.

"The requirements of logistics are seldom understood. The conflicting demands of our theater commanders, of Allied sover-

One member of crew guides tank across spanners from one flat-car to the next as a trainload of fighting machines starts for war front over the Santa Fe Ry.





eign powers and of the home front, pose difficulties never before approximated. The necessity for a high degree of efficiency in management is evident and it has been found in the coordination of all the various supplies and administrative departments of the Army under the command and leadership of Lt. Gen. Brehon B. Somervell."

There is nothing that delineates so sharply the global quality of this war as the map of the supply routes. It is 28 days by ship from San Francisco to Sydney; 12 days from Seattle to Kiska; 17 days from New York to Liverpool; 42 to 70 days from New York to Basra. Casablanca is nearly as far from Tunis as New York from Miami. How an army and its materiel flowed across 1,000 miles of North Africa by feeble railways and poor roads, with help from transport planes and portable pipe lines, is another epic. Scores of locomotives and hundreds of freight cars



Assn. of American Railroads

With fewer but more powerful locomotives than in 1918, railroads are hauling war freight with little confusion

At left, a railroad tank car is prepared to take on a load of oil for the eastern seaboard at a station in Texas

Trainees at army motor operations school learn how to pull a truck out of a tough spot in Wyoming mountains





Many fighter planes hop the Atlantic "on their own." This P-38 Lockheed Lightning is being hoisted from a transport's hold at an English port

were shipped from the United States. Coal had to be shipped to run them, and loaded by hand. Trains operated in total blackout. One bit of fortune was the discovery of 20 or more "General Pershing" locomotives that had been sent to France in World War I to haul ammunition for the Yankees, and afterward sold to France. They turned up on the railroads of Algeria and Morocco and are doing business again for Uncle Sam.

Caravans of motor trucks rolled along North African roads, refueling from gasoline cars cached by the thousands. The British estimated that 70 percent of all

without a locomotive. They took apart two army trucks, installed boxcar wheel rims on their wheels, adjusted the gauge to fit the rails, and handed the army two serviceable if makeshift engines.

The tonnage of stuff being moved is unbelievable. In one six-week period of heavy fighting on a single front 38,000,000 rounds of ammunition were hauled to the firing line and exploded in the Nazi's face . . . about ten shots per second, whether pistols or machine guns or blockbuster bombs. The ground forces alone had to be supplied 300 different types of ammunition.

They also had to be fed and clothed. And a half million pounds of soap was just one item on the bill of lading.

Our railroads are also rather busy. In 1943 they hauled as much freight as in the combined years 1918, peak of World War I traffic, and 1939. Passenger traffic in 1943 was well over 1918 and 1939 together. Army freight moves at a rate of 4 million tons per month, more than four times the 1918 rate; 2 million soldiers and sailors travel by rail

Self-propelled army rail car has wheels adjustable to any gauge from 30-inch Australian track to 66-inch Russian track



every month in organized groups, in addition to the vast number traveling on furloughs. Every day the railroads carry 1,500,000 passengers, haul 2,000,000 tons of coal and deliver about 40 million gallons of oil to the east. Each day they move 4,600 carloads of freight to ports, and twice that much to domestic military posts.

It probably makes Dr. Goebbels of Berlin a bit sick to eat the words he spoke about two years ago, when he prophesied that our railroads would break under the war load. He pointed out that we entered the war with 10,000 fewer locomotives, 500,000 fewer freight cars than at the start of World War I. But those freight cars, he neglected to say, average 25 percent greater capacity than in 1918, they are being loaded 10 percent nearer to capacity, they move 50 percent faster behind locomotives incomparably more powerful, and the "turn-around" has been accelerated tremendously by rapid loading and unloading.

Railroads measure their work in ton-miles—one ton carried one mile. In 1943 they reported an estimated 730 billion ton-miles, compared with 638 billion ton-miles in 1942. Railroad passenger-miles for 1943 were estimated at 85 billion compared with less than 54 billion in 1942. And for 1944 the railroads expect another rise of 6 percent in freight tonnage, 15 percent in passenger traffic.

Over in Iran, lend-lease material for the Russians is moved over an American-operated railroad carrying 10 times the traffic of the Burma Road at its best.

The problems of logistics include the supply of flour, milk, sugar, olive oil, meat, medicine and soap to the peoples of liberated Africa, Sicily, Italy. They include the problem of delivering to Russia 6,500 airplanes, 3,000 tanks, 125,000 submachine guns, 170,000 trucks and jeeps, 300,000 tons of chemicals and explosives and a vast tonnage of food and drugs. Perhaps the toughest of General Somervell's assignments is that of moving personnel, equipment, and supplies into China after transporting the materiel halfway around the globe.

World War I seems but an afternoon skirmish by contrast with this war on six continents and seven seas. By good fortune and hard work we have the world's greatest air fleet and a Navy without a peer, an incomparable system of railroads, an army and an industry rolling on wheels by the million. We are building ships faster than they are sunk and sinking submarines faster than they are built. The war of logistics, the biggest business on earth, is being won. Our fighting men are the best equipped and the best supplied.

"The end is not yet clearly in sight," says the Chief of Staff, "but victory is certain."

Grass Planter Digs and Waters In Time-Saving Operation



Grass can be planted in the hottest and driest months at the San Antonio, Tex., aviation cadet center, with a combination garden hose and grass planter invented there. The planter was devised to plant Bermuda grass runners on barren land, and water them all in one operation. It consists of a piece of iron pipe about the length of a broom handle and having a connection for the attachment of a garden hose. At one end of the pipe is a piece of flat metal with a slightly concave edge for pushing down sprigs of grass already dropped into holes. The end of the pipe discharges water continuously. The operator handles the instrument like a spade.

"Rubber" Cement Bonds Metal To Thin Plywood Veneer

Plywood only $\frac{1}{8}$ inch thick can be cemented to a metal surface by means of a new type of rubberlike adhesive developed by the Goodyear Tire and Rubber Co. A metal sheet of any thickness bonded in this fashion to a layer of wood can be bent into any shape or cut with shears or stamping press without cracking the wood or pulling it loose from the metal. Other metal units can be welded to the back of the metal sheet. The new process, which requires no critical materials and is economical, is expected to revolutionize and improve the design of building interiors, homes, furniture, airplanes, automobiles, railway cars, and ships in peacetime.

"Pliant"

Arthur M. Kelly, Chgo., Ill., Glencoe, Ill.

0125

*Drawing by: S. W. Clatworthy on Pages
246-247, The Sphere, London, Feb. 19, 1944*

The FLEET HITS



Backing up the land forces with naval gunfire is a World War II innovation highly developed by the Allied navies. Destroyers, cruisers, and even the big battleships help soften up enemy strongholds. The drawing across the top of these pages shows the naval bombardment as seen from shore. The high-

curved trajectory of the shells is adapted to bombardment of unseen targets. The lower drawing, a partly cutaway view of a destroyer, shows the action on board during an attack. Two Army artillery officers help direct the fire, a forward observation officer and a liaison officer. The observation officer is put

the FRONT LINE

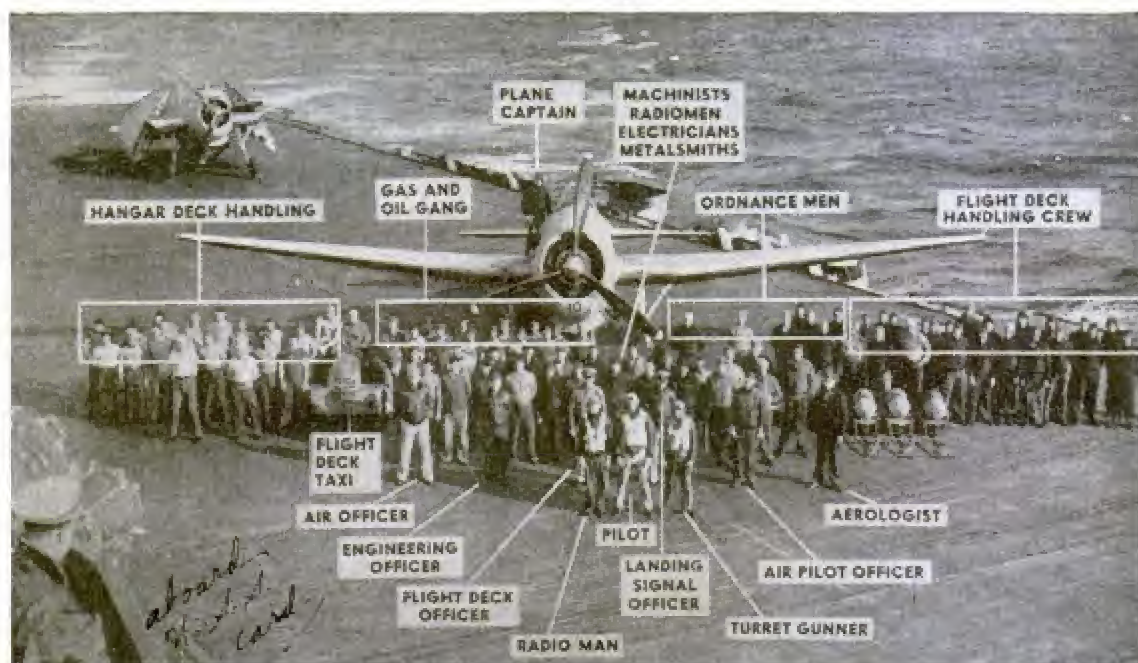


ashore by boat or parachute, or is flown over the target to direct the fire by radio and spot the results. His reports are passed along by the liaison officer to naval fire control officers. Principal change in the firing is that the charges are reduced for lobbing the regulation shells. Note how the guns are ele-

vated to give the howitzer-like trajectory. The numbered chart (inset) shows ship stations which are operated under special conditions during the bombardment. This type of shelling was used with success in Sicily, Italy, and in the South Pacific

Drawing copyright by S. W. Clatworthy

Single Carrier Plane Requires 97-Man "Crew"



When an Avenger torpedo bomber swoops in for the kill in an attack on an enemy convoy, the men in the plane aren't the only ones responsible for the success or failure of the mission. Though they are largely unheralded in the official communiques, the men left behind on the carrier are all part of a 97-man "crew" that

is required to keep the bomber in the air. These officers and men have such varied duties as keeping the plane, its equipment and armament in repair; handling the craft both above and below decks, seeing after its power plant, directing the pilot in take-offs and landings, and helping direct the craft home from its mission.

Camera Photographs Night Sky as Aid in Aerial Mapping

Pictures of the stars are being used to determine the exact latitude and longitude of areas being mapped from the air. "Zenith cameras" which take the photos of the night sky are said to be able to fix the exact

position of a spot on the earth's surface within 40 or 50 feet, a minute margin of error considering that the earth's circumference is 131,000,000 feet. One or several "zenith cameras" are placed within the area being mapped, and the "star data" is later coordinated with the aerial pictures. The equipment includes three units, one camera to make a picture of the portion of the night sky immediately surrounding the zenith; another camera simultaneously photographing three navigation watches, set on Greenwich time, and an automatic timing unit which operates and synchronizes the other two. Pertinent information about the mission on which the camera is used is also photographed on the same plate. Having the time and the position of the stars, men who know nothing about astronomy are able, with the aid of a catalogue of stars, to establish the exact location of the point of observation.



THEY MAKE TOMORROW'S PLANES TODAY



Major John P. Leggett

THOSE Zero pilots had it coming to them. For weeks they had been having things their own way, sneaking out of the sun and up behind Uncle Sam's big bombers to pour in a hail of machine gun bullets that knocked many a winged warship out of the Pacific skies. Back to the United States went an urgent plea for help.

Engineers went to work and quickly came out with the answer—a gun compartment to be built into the tail of the sky giants. But time was flying, and more bombers were being shot down; there was no time to wait until manufacturing plants could be re-tooled. With that in mind, Army Air Forces sped the decision to the theater—the bombers must be modified right in the field. And the next time the Zero pilots came zooming to the kill, they were met by a deadly blast from the “stinger” in the tail of each bomber.

Today such modifications rare-

† Workers at Tucson modification center convert the Liberator used as Prime Minister Churchill's personal plane into a transport

Until modification plants placed a tail gun (below) in B-17, Japs had a vulnerable spot for attack





as Boeing's B-17 or Consolidated Vultee's B-24 and its transport prototype, the C-87.

Modifications on Consolidated aircraft are accomplished at a large center located at Tucson, Arizona, new planes being flown directly from the Consolidated plant at

To the front turret of the B-17 (left) a chin was added to provide more sting (below)

U. S. Army Air Force photos

ly need to be accomplished in the field. It's true that some changes are effected by mechanics in the various theaters, but major alterations are made at modification centers — huge engineering-manufacturing plants to which most new aircraft and many old ones are sent to be prepared for action in a particular area, such as the desert, or the Arctic or the tropics.

There are a number of these modification centers in the United States. In general, each will be assigned the job of modifying a certain type of aircraft, such as fighters, or a certain manufacturer's product, such



San Diego to Tucson for the necessary changes before going in any theater.

This case history illustrates how this system operates:

Two engines were dead and half of the tail section appeared to be shot away as the big bomber rolled to a stop on a field far from America's shores. Hurriedly the crew reported and a few hours later, certain portions of their report were handed to officers of the Special Projects Branch of the Materiel Center, Wright Field, Ohio. And these officers wasted no time in studying the report, which recommended certain changes in the B-24, suggestions which resulted from that last mission.

Less than a week later, some of the changes requested—incidentally by this air crew in North Africa—were being incorporated into new B-24 Liberators on the modification center at Tucson. Quick change artists, these boys at Tucson, and similar centers, for they must meet the ever

On the Tucson plant's "zipper line" workers fit de-icer boots on the leading edges of wings and stabilizers

and swiftly changing problems of the war. Shifts in enemy tactics must be met by immediate changes in Uncle Sam's equipment, without upsetting the flow of airplanes off the assembly line at the manufacturer's plants.

Instead of being just a place where aircraft may be prepared to fly in a certain area, the modification center is the means of avoiding the "freezing" of designs which volume production usually requires. This flexibility, permitting changes and additions to be made on today's airplane, rather than on a drawing board of next year's model, often results in a saving of lives, and certainly increases the fighting ability of the equipment.

Two types of operations are performed on aircraft at the Tucson center; first, alterations required to fit an airplane specially for the climatic and other conditions in which it will be operated, comprising some twenty-five percent of the center's work; and second, modifications required by the Army Air Forces and usually involving changes for improvement of the plane's defense or offense, comprising the other 75 percent of the plant's operations. The second class of modifications may be accomplished at Tucson for a few days or a few months, depending upon the time required by the Consolidated factory to adjust its assembly line procedure to permit the new change in design to be incorporated in the aircraft when first assembled.

Factory assembly lines never can take care of changes necessary for planes going to certain areas. The factory produces aircraft that may go to frozen Alaska, torrid Africa or the steaming tropics; operating conditions are different in each place. So the Tucson center must make changes.

Liberators bound for the Arctic are given special winterization treatment — carburetor heat controls, additional cabin heating, de-icing facilities and similar changes. Similarly, B-24s to be used in the desert areas receive attention that will permit the most efficient operation there. For instance, some parts of



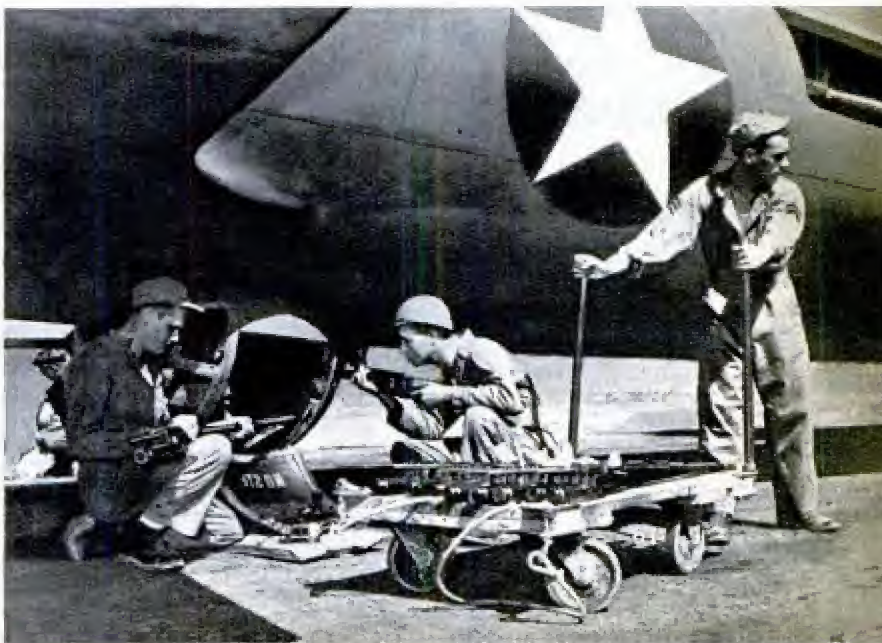
Plexiglas sections for turrets are formed by being heat-bent over chiseled-out wooden forms above. Form at left will cover nose turret

the big bombers must be protected from the abrasive-like sand; special air cleaners are installed to sift out dust and keep it out of electrical and hydraulic equipment; special paint jobs make the bomber blend with its desert surroundings.

The Tucson plant's biggest job, preparing tomorrow's planes today, gives the Axis some of its biggest headaches. Just imagine the surprise of the first Japanese pilot who swooped up beneath the Liberator to attack what had been its unprotected belly and was met by crackling machine guns mounted in a ball turret that popped out in his face!

That turret came into being as the result of reports, telling of successful attacks by enemy aircraft on the undersides of Liberators, reaching Wright Field. There officers studied the problem day and night until they decided that a turret should be

Armors at modification center must keep 50-caliber guns in fighting trim





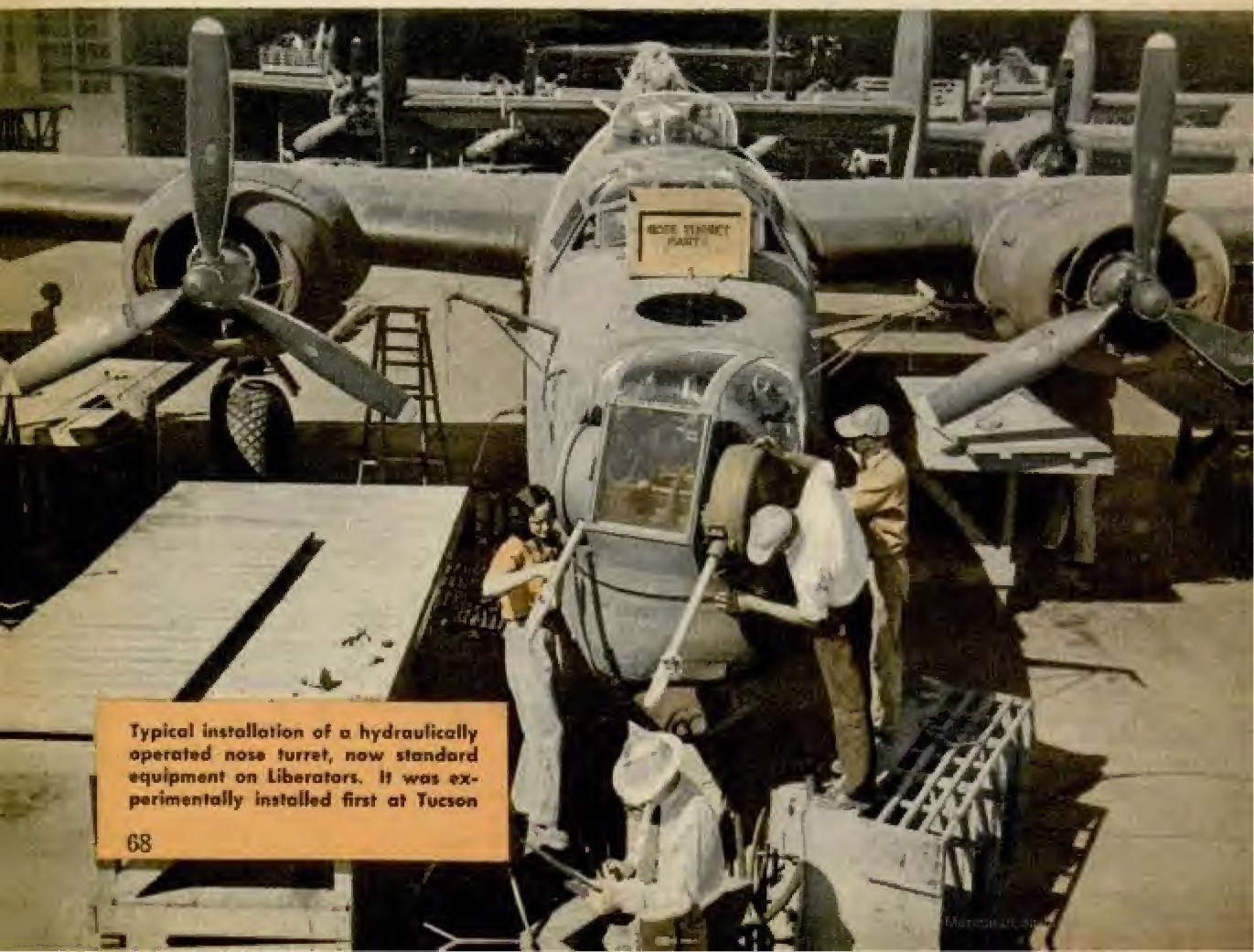
Preparing a life raft "tub" in Tucson modification center's sub-assembly department. Plant readies planes for particular areas

provided. Because the Liberator is so low to ground when it lands, the turret had to be retractable into the bomber. Sperry developed the original turret, but it could not be installed immediately on the assembly line at Consolidated, due to the many changes necessary. So the first installations

were made at Tucson, thus avoiding the delay that would have resulted from re-tooling and re-arrangement of work routine at the factory.

Of course procedures at the modification center were not in accord with the customs and practices of engineering because operations began with nothing except layouts and sketches. It was a case of "quick and dirty tooling" and rule-of-thumb engineering at the start. But these methods were fast and scores of Liberators equipped with the turrets reached the combat area several weeks earlier than they would have if it had been necessary to wait for the factory to get set and come into production.

As fast as Consolidated bombers and transports are ferried from San Diego to the Tucson center, they are pulled by tractor from their landing point to places on the modification lines, some six in number. All these lines go through the center's three 700-foot hangars. Two of these hangars have lines which are called "zipper lines." On the zipper line, the planes are staggered so that the wing of one passes a few



Typical installation of a hydraulically operated nose turret, now standard equipment on Liberators. It was experimentally installed first at Tucson



Flyers at left admire B-17's tail machine gun. Below, a Flying Fortress model whose design and equipment profited from modifications made after experiences in combat



feet behind the empennage (tail assembly) of another. Each of the twelve stations on a line are manned by a crew chief and three assistants, each on a specialized job.

Virtually every job is of such a rush nature that the modification engineers have no time to prepare special tools and dies; as a result, fabrication workers necessarily become resourceful and work fast.

For example, installation of life rafts may be desirable. Stock for them may be cut with tin snips and hand-formed over maple blocks; then the holes cut in the upper part of the fuselage for the raft hous-

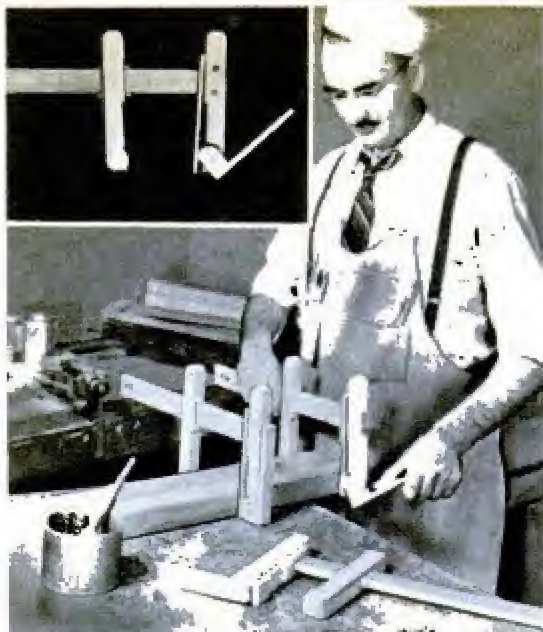
ings. Covers then will be fashioned and automatic release mechanism devised.

Small parts frequently are produced on small benches and tool room lathes, although a 60-ton hydraulic press also is among the center's equipment. In spite of all the tools at the Tucson plant, the workers there are proudest of such achievements as that of a man who devised a burring tool out of a dime store knife sharpener.

The modification engineer must be almost as resourceful as the mechanic at some isolated air base, and he usually is, for the job is done, and done well.

This is one of the early B-17 models which later underwent changes at modification centers rather than await the re-tooling of manufacturing plants. Thus they could be rushed back into combat zones much more quickly





Lever-Type Clamp of Wood Has Wide Capacity Range

Using a single action leverage principle of operation, a clamp made entirely of wood provides a quick and secure clamping action. Parts to be clamped are merely inserted between the "jaws," the sliding arm moved up into position, and the hinged lever flipped down. The clamp weighs only 12 ounces and has a capacity ranging from 1/2 to 11 inches. Its greater capacity and versatility eliminates the need for several types of clamps for different capacities.

"Turtle" Blade on Cut-Out Knife Withdraws Into the Handle

By turning a knob on the tip of a pencil-shaped handle, the two-edged blade of a cut-out knife is withdrawn into the handle. The sharp blade can be extended for a deep

cut or the thickness of a single page. The tool is handy for cutting stencils, clipping magazines, trimming photographs, and is also used by printers. When the "turtle" blade is withdrawn into the plastic "shell," the knife can be carried clipped to a pocket like a pencil.

Army Does Outdoor Cooking In Asbestos Container

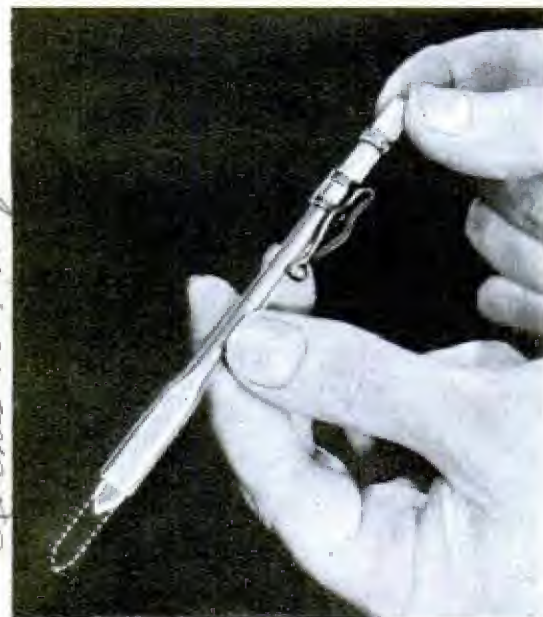
United States army flyers and medical corps men carry a collapsible container made of lightweight, seamless asbestos fabric coated with synthetic rubber for emergency use. The bag can be hung from a



makeshift tripod over an open fire to serve for cooking purposes or for sterilizing operating instruments. After the war it is expected to be ideal camping equipment.

Fast-Drying Concrete Cuts Cost Of Prefabricated Houses

Concrete has become a low-cost material for prefabricated houses as a result of the quick-drying treatment perfected by Grosvenor Atterbury, director of research for the Yale University department of architecture. In the new method the forms must remain in the molds only a fraction of the time required formerly, when slow-hardening in expensive molds necessitated a large investment for plant and equipment. The ensuing greatly increased output of the plants is said to reduce substantially the cost of the finished home.



Empire Lead Mfg. Co.
Milwaukee, Wis.

Mark Specialty Co.
406 E. 5th St.
Albany, N.Y.

W. D. Groshen Co., Rochester, N.Y.

*Edo Aircraft Corp. 086
College Point N. Y.*

Seaplane Can Alight On Land and Snow

Pontoon gear with wheels or skids has been devised to permit seaplanes to alight on water, land or snow. One set of floats, used by medium size planes, has wheels which are electrically retracted and lowered by two switches, one



for the two bow wheels and one for the two main wheels. Main wheels retract into wells located aft of the step. Both main and bow wheels are equipped with hydraulic shock absorbers and with water rudders which are hooked to the air rudder controls by cables. The metal floats can be landed

on snow or water. Smaller floats for the light plane, instead of retractable bow wheels, have nonretractable bow skids supported by shock absorbers and fitted with nonabrasive shoes. The skids are so designed that they follow the unevenness of the ground and do not "dig in" the water.

Lightweight "Tank Buster" Shoots Bombs That Pierce 4-Inch Armor

Light enough to be carried by infantrymen and yet powerful enough to knock out enemy tanks and pillboxes, the "Piat" (projector infantry anti-tank), a British

weapon, does a job similar to that of the American bazooka gun. The Piat weighs 33 pounds, less than the old anti-tank rifle, and can be put into operation in a few seconds. It fires a 2¾ pound bomb which can pierce four-inch armor plate. A spring mechanism insures so light a recoil that the Piat can be fired from the shoulder. Infantrymen using it in that fashion, with the fore part of the weapon rested, have been trained to hit a moving tank at a range of 100 yards. It has proved effective at destroying machine gun nests up to 350 yards. The bomb explodes on impact, the propellant force being derived from the explosion of a cartridge in the tail assembly.





SILVER GOES *to* WORK

Silver owned by U. S. Treasury Department at West Point depository being released for war use on lease-lend basis. Below, silver is in the emulsion on motion picture film, which army technician is shown splicing in a Signal Corps editing room

Signal Corps photo

FOR thousands of years second only to gold among the precious metals of the world, prized as a measure of wealth and a medium of exchange, silver today is doubly precious for a new and vastly different reason. It is helping win the war in the nation's factories and wherever battles are being fought.

Industrial uses of silver, now primarily in war production, have multiplied and expanded so rapidly that industrial consumption has doubled twice in the short span of four years. Even the doors of the U. S.

POPULAR MECHANICS



OWI photo
Women learn to braze silver
in an aircraft construction
class at vocational school

Treasury's silver stronghold at West Point have been thrown open, figuratively, to industry, and thousands of tons of the white metal have been loaned to manufacturers for non-consuming purposes.

So valuable and vital has silver become as a war material, that there are few war industries which do not use it in one way or another, either as a substitute for copper, tin or other strategic metals, or because of its own inherent and exclusive advantages. Even as Pizarro, conqueror of Peru, once shod his horses with silver in an emergency, the United States and its allies have turned to silver to solve countless war production problems, and with outstanding success.

In 1943, something like 170,000,000 ounces of silver went into industrial use, and of this only around 10,000,000 ounces were used in the arts field, including silverware, jewelry and other nonessential products where use is curtailed. In round figures, industrial consumption in 1942 was 120,000,000 ounces; in 1941, 80,000,000 ounces, and in 1940, only 40 million ounces.

But despite this rapid increase, and with the United States alone using practically as much silver as now is being produced in the entire Western hemisphere, the government found it advisable to place enormous quantities of Treasury silver at the disposal of industry.



Eastman Kodak photo
Rolls of 35 mm. motion picture film are stacked and ready for shipment to army units. Below, rolling a wide sheet of sterling silver at Handy & Harman plant, world's largest. Industrial use of silver has doubled twice in four years



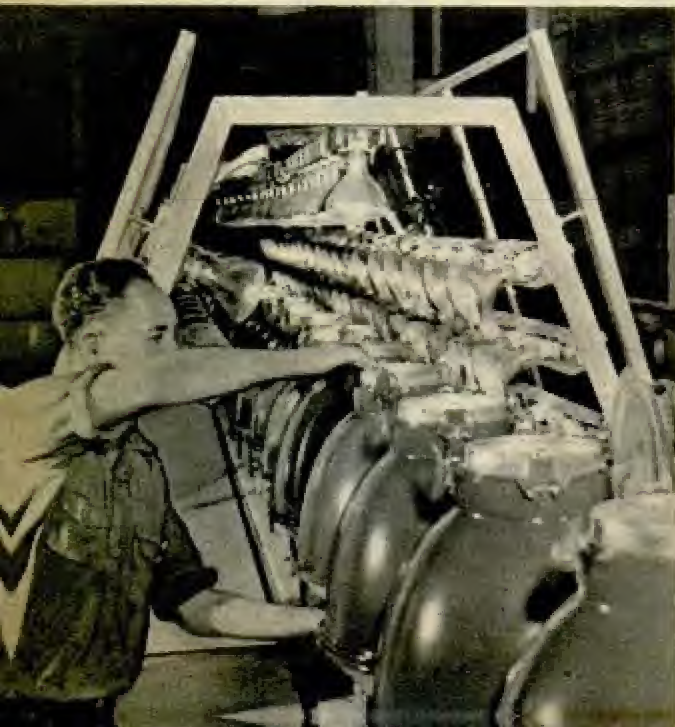


Western Electric photo

Adjusting relays (in which large quantities of silver are used) in Navy telephone switchboard

In West Point vaults comparable to Uncle Sam's gold fortress at Fort Knox, Ky., are well over three billion ounces of silver. Part of this is required to back United States currency, and the remainder is known as "free silver," now available for industrial use through the Defense Plant Corporation or held for sale at 71.11 cents an ounce, the fixed price for domestically mined silver.

Of the first billion ounces (34,460 short tons) of this "free silver" released, about



19,000 short tons were certified for industrial allocation within a year. On the loan basis, all of this Treasury-owned silver must be remelted and returned in its original bar form after the war. Thus, it cannot be alloyed, and is used principally in bus bars (primary electrical conductors), wire strip for transformers and experimental cable for overhead power transmission lines. In most cases, this silver replaces scarce copper. The big bus bars, which are cast or rolled but never drilled or sawed, are used in war plants and are kept under guard, although weight plus high voltage usually preclude theft.

Even a hasty review of wartime uses of silver makes it easy to understand why such huge quantities of the white metal are needed. Approximately one pound of silver originally is required for each airplane engine bearing. Some is reclaimed for reuse after manufacturing processes are



Above, a Gorham craftsman modeling silverware. Left, General Electric used silvered glass instead of aluminum for reflectors, saving 560,000 pounds of aluminum in the manufacture of lighting equipment

complete, but the net total finally used is around one-third of a pound per bearing.

So successful has been the use of silver in plane engines that many tank engines now have silver-alloyed bearings and even the small bearings in high-speed superchargers contain silver. No other metal has been found that is so effective in high horsepower power plants.

The Army and Navy ordnance departments are among the largest users of silver. Much of it goes into brazing alloys used in

the fabrication of shells of all types including those used in chemical warfare. The Navy now uses silver brazed connections for its non-ferrous piping in ships.

One of the nation's largest makers of electrical equipment reports that almost every motor, generator, transformer or other piece of apparatus made for the war has silver in its construction. Despite the cost of using silver, the advantages in current-carrying contacts result in an improvement in quality sufficient to justify its use, and silver brazing alloys are making joints by the million on a competitive basis with other joining methods. These alloys are used widely in airplane construction, in the making of electrical equipment and in fabricating large copper piping for marine uses. The saving of more than 50 percent is effected, in no small measure, by the use of increased silver content in alloys.

Brazing alloys, developed to a high degree of perfection through the use of silver, account for a large proportion of the wartime consumption of the precious metal. According to General Electric, one type of brazing alloy, widely used before the war, was composed mainly of copper, the remainder being silver and phosphorus. Now, alloys with copper content as low as 16 percent are in general use. A typical alloy consists of 50 percent silver, 16 percent zinc, 18 percent cadmium and only 16 percent copper.

Before the war the electric household refrigerator industry was a leader in using silver brazing, and was the largest industrial consumer. No soft solders were used on connecting lines because early use of these materials led to the production of considerable equipment which developed defects in that the solder failed in service, resulting in gas leaks. To prevent troubles from such causes most states now require silver brazed connections.

Not only does silver excel copper as a conductor of electricity, but it has many outstanding physical and chemical properties, one of which is a heat conductivity higher than any other metal. Some of the other advantages of silver in industrial use are explained by Robert H. Leach, vice-president of Handy and Harman, largest silver plant in the world, at Bridgeport, Conn., who says:

"The photographic industry has become a large consumer of silver; millions of ounces are used each year. The silver is converted into silver nitrate and as this has to be of a high degree of purity its production is confined to large companies which manufacture photographic equipment and supplies or to chemical companies

Continued to page 148

Portable Film-Carrying Case Serves as Projector Stand

0132



*Bell & Howell Co.
1801 Archwood Ave.
Chicago 13, Ill.*

Instead of stacking books on a chair every time home movies are to be shown, amateur operators can convert a portable carrying and storage film case into a projector stand. Closed, the case is 12½ by 24½ by 7 inches; when opened out, it stands 42 inches high with a platform 12½ by 24½ inches suitable for any size projector or as a speaker's rostrum.

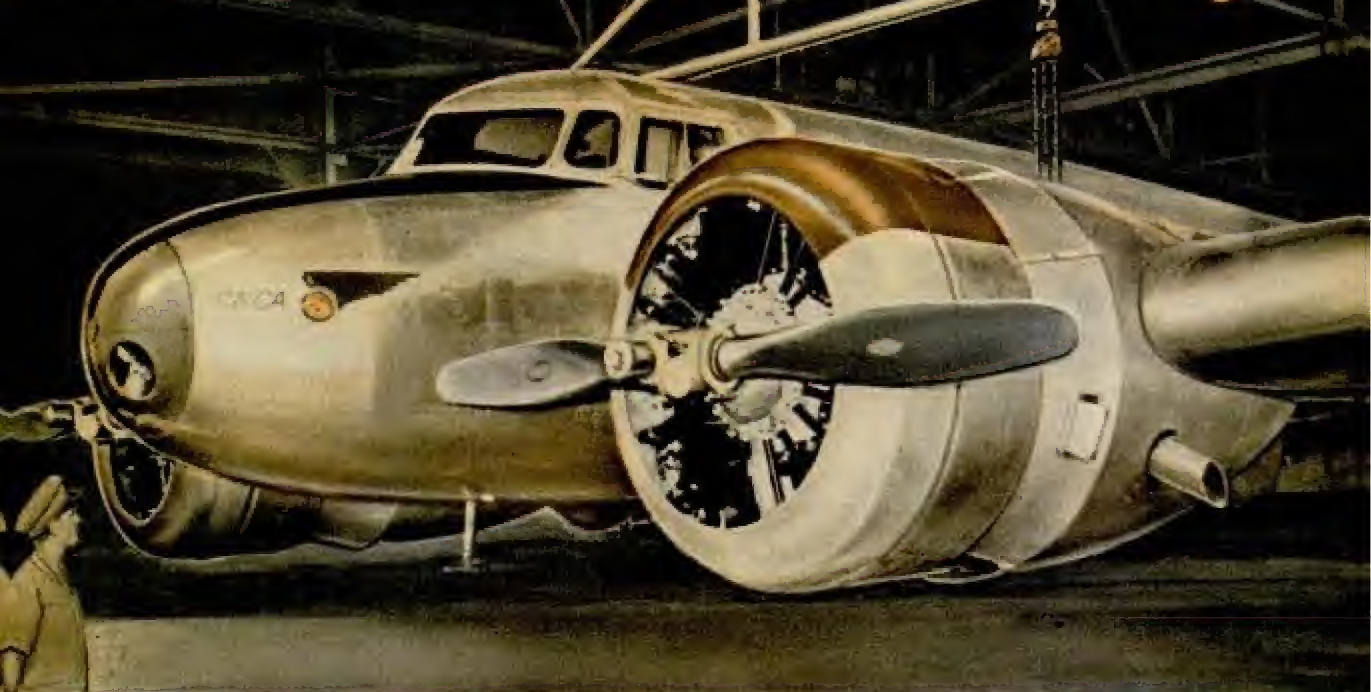
0166

Insulating Wall in Radiator Niche Saves Seven Percent of Fuel

By placing insulation behind radiators recessed into the outside walls of modern homes, as much as seven percent of the winter fuel can be saved, tests by University of Illinois engineers reveal. The tests, made in a typical brick veneer small home, showed that heat loss for each square foot of recess equals as much as that of 16 square feet of the insulated wall. The tests were made by installing in each radiator recess 1-inch rigid insulation with aluminum foil reflective surface.

*Urbana, Ill. in cooperation with
2. White. E. Smith & Radiator Mfg. Co.*

FEATHERWEIGHTS ON WHEELS



"Weighing in" a new twin-engine airplane at the factory on Fairbanks-Morse suspension scales

ADD more lightness" will be the watchword of transportation equipment manufacturers in the postwar era.

Everything from baby carriages to locomotives will be scrutinized by engineers whose job it is to find and remove each ounce or ton of unneeded heaviness. Re-

ducing the deadweight of a vehicle improves its efficiency, cuts down fuel costs, or increases its load carrying ability.

It is estimated that if one pound is removed from the weight of a medium-sized passenger transport airplane, its payload capacity is increased by \$2,000 during its operating life. In the case of railroads, cutting half a ton from the weight of an ordinary freight car permits a saving of up to \$15 for the car per year because of the reduced hauling effort. The automobiles talked about for the future, using lightweight metals and plastics to reduce their weight, will be capable of the same speeds, comforts, and carrying capacities as present cars, yet will require smaller engines. That means more miles per gallon of fuel.

Engineers have been talking about weight control for decades but not until the war made airplane poundage a deadly serious



Two small landing wheels on the Constellation weigh less than one large wheel

3872 Franklin Ave. 058
 Los Angeles 27, Calif.

matter did weight engineering become a formal art. Every pound that is saved in building a military airplane may then be used in providing more armor, more bullets for its machine guns, or for greater bomb or fuel load.

Today at Lockheed Aircraft Corporation as at other large aircraft factories a staff of special industrial dieticians watches over each new design to chisel off superfluous avoirdupois without reducing the plane's flight ability. Much of the engineering knowledge gained in aviation may be applied to other kinds of transportation, and the Society of Aeronautical Weight Engineers is making its findings available to all industry.

At Lockheed, L. R. Hackney and his staff work hand in hand with the de-



This 15-foot section of "barrel" fuselage of Constellation (above) weighs only 50 pounds more than the workman

Two aircraft radio masts of magnesium on scales at left exactly balance a single identical mast of heavier alloy

The triple tail of the Constellation provides maximum stability and control with the minimum structural weight



Prof.
 Mrs. L. R. Hackney, Engineering Dept.
 Lockheed Aircraft Corp.
 Burbank, Calif.





Weight engineers must determine a landplane's "water line" and length of time it will stay afloat, and specify location and size of flotation bags carried for emergency. Below, P-38's four machine guns and 20 mm. cannon present a problem of weight concentrated in nose



sign and stress departments, for a decision that affects weight also bears on the plane's center of gravity, its strength, and its performance. Sometimes the engineers can redesign part of a structure to save poundage, sometimes they can substitute a lightweight metal or plastic for a heavier material. Sometimes, however, they deliberately select the heavier of two materials in cases where it proves to be really the lighter when installed in the plane. An aircraft part that is made of stainless steel is much heavier than its duplicate in aluminum, for instance, yet in some applications it may add the least to the plane's empty weight, since less steel may be needed to carry the required load.

The same sense applies to equipment. Of two electric motors that can perform the same work, the heavier may be selected if it uses less current than does the other. The smaller conductors required for the reduced current may cut down the weight of the whole installation.

The importance of such details is illustrated by the big four-engined Lockheed "Constellation." Hackney and his staff were able to reduce its weight by 3,000 pounds under the original estimate of its tonnage. In effect that amount was added to the airplane's carrying capacity. Thus in a passenger transport version of the "Constellation" one and a half extra tons of cargo weight will be available.

In spite of the accomplishments of the weight engineers, airplanes today don't carry as high a percentage of useful load as they did in the past. In 1929 a tri-motored Fokker could lift a useful load amounting to 40.5 percent of its gross weight, as against the approximate 36 percent useful load of a modern transport. This loss in payload efficiency is partly because modern aircraft are of sturdier construction and partly because a great deal of equipment that adds to safety and comfort is now being carried. The old Fokker carried 75 pounds of radio equipment; the radio gear on a modern airplane weighs some 500 pounds. In all, about 220 pounds of safety and comfort equipment per passenger are carried by a modern transport.

Empty or loaded, an airplane's center of gravity and its balance are vitally important. The control of these factors is a part of weight en-

gineering. Recently a flying boat in a squadron crossing an ocean was unable to keep up with its companions although all the planes were operating at the same engine settings. The pilot of the lagging plane saw that his trim tabs indicated nose heaviness. He shifted some of his cargo to the rear. That allowed him to fly with the tabs neutral and at once the flying boat picked up speed. Recently, too, a cargo plane loaded for a trip abroad lurched into the air on the



New lightweight railroad car is suspended by pedestal coil springs. At left, set of dials responding to mockup of the hydraulic system of a plane are studied by weight engineers

and when the plane took off again it flew smoothly. The meticulous balance required in an airplane is not so necessary in a vehicle that has four wheels on the road, but lack of correct balance explains in part the poor handling characteristics that drivers of some cars have complained of in the past. The light cars of the future, engineers predict, will be improved because of the new understanding of centers of gravity and balance that has been acquired in aviation.

In the commercial truck and bus field, lightweight aluminum or magnesium bodies promise to cut down gross weight and allow vehicles to carry the same payloads at reduced fuel expense. Torsion bar suspension, first tried out in the United States by race car drivers, is receiving attention in the truck and bus fields because of its weight-reduction possibilities. A torsion bar, one end

Continued to page 154

takeoff, flew crazily, and changed altitude unpredictably. The experienced pilot had his hands full in returning safely to the field. Under the supervision of an expert the cargo was reloaded to provide a correct center of gravity

Samples of stuffing for aircraft seats weigh alike; the larger one consists of hair and latex, the smaller one is foam rubber



Mr. G. H. H. 78th St. N.Y.
 N. Y., 16 N. Y. 0152

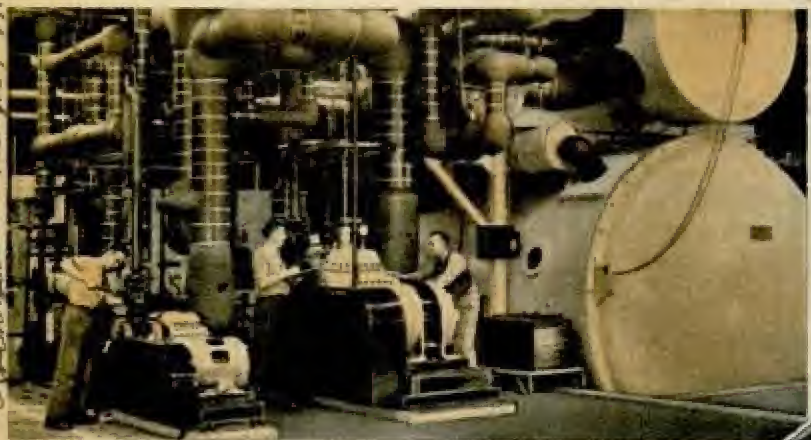
HIGH FLYING on the GROUND



Guarding the lives of U. S. flyers who fight in the stratosphere seven and eight miles above the earth, are high altitude engineers who work in 75-below-zero chambers simulating altitude of 60,000 feet. Above, engineer checks action of a Sperry gyro-pilot. Right, exercising protects against "bends"



The Sperry Corp., 78th St., N.Y.
 Rockefeller Plaza, N. Y.



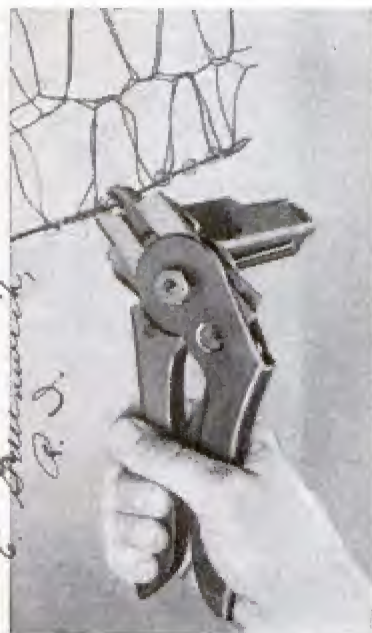
Refrigerating machinery and pumps dwarf "strato" tank in Sperry laboratory. Below, observer in sealed lock can open door quickly if anything goes wrong "upstairs." Below at right, naval officer questioning test crew inside tank



Bombs on Fighter Plant Felt Quickest at Front

When an assembly plant for fighter planes is bombed, the effect is felt on the front line in two weeks. If raw materials are blasted, it takes 10 to 25 weeks before the enemy's fighter squadrons feel the shock. A chart made from statistics supplied to the Secretary of War by the commanding general of the Army Air Forces also shows that the bombing of plants producing unfinished parts for fighter craft is felt on the front lines in five to 10 weeks. Plants that build such planes, vital for the defense of Fortress Europe, have long been a favorite target of American and British bomber crews.

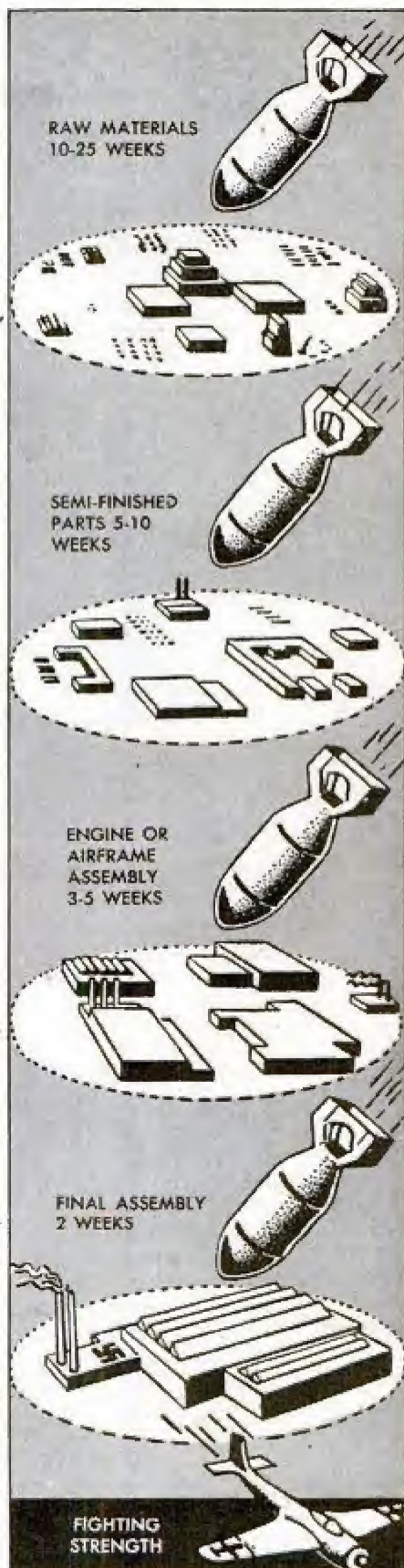
Stapling Pliers With Magazine Feed Join Strips of Wire Netting in Jiffy



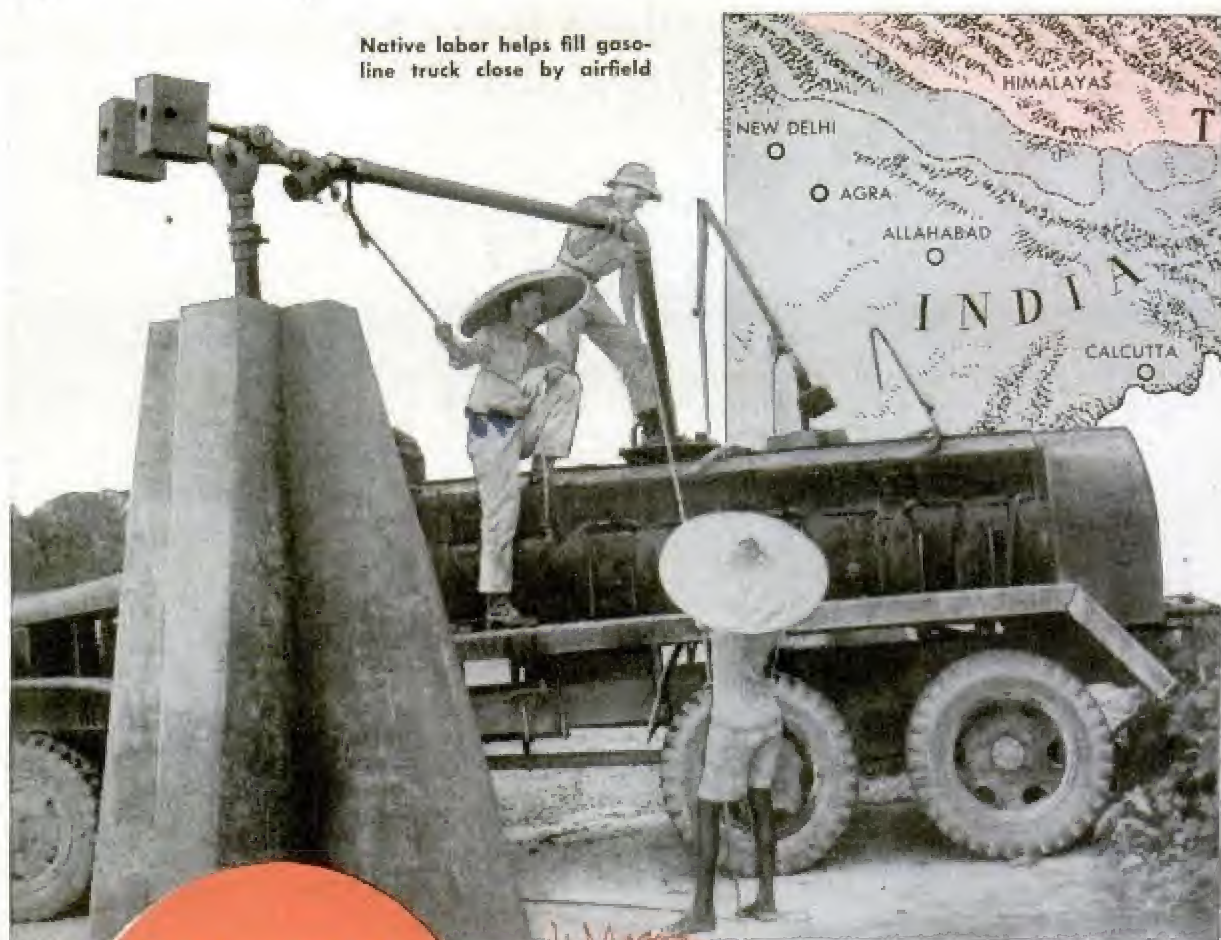
Magazine-fed pliers, which hold 60 to 70 ring staples in one loading, are used to speed the joining of strips of wire netting and fence wires. The two-pound pliers are operated like those used to set rings in hogs' noses. Magazine-feeding saves time by eliminating the hand-placing of every ring. Pressure on the handles of the tool locks the rings with a quarter-inch overlap which holds them securely in place.

Coast Guard Asks "Impossible" Stunts Of Its Helicopter Pilot Students

After 25 hours of flight training, a helicopter pilot student is required to put his machine through a series of "impossible" stunts, Lt. Comdr. F. A. Erickson writes in the United States Coast Guard magazine. He must (1) take off sideways and climb at a 45-degree angle; come down the same way but stop and hover before setting the ship down; (2) take off backward and fly tail-first; at 25 or 50 feet altitude, while continuing flight in same direction, swing tail around and go on nose first; (3) from 200 feet altitude make 60 degree glide and land on marked area approximately 20 feet on a side; and (4) fly around the boundary of a square, stopping in the air at each corner, without deviating more than one foot, vertically or horizontally, from true flight line. Comdr. Erickson said the training is preparing pilots for the Coast Guard's peacetime uses of helicopters in rescue and ferrying work.



Native labor helps fill gasoline truck close by airfield



HEROES of the "HUMP"

By Wayne Whittaker

FROM the crude loud speaker of the radio perched on a packing crate in the center of the bamboo hut came weird whistles and scratches. Eight pairs of ears belonging to the American flyers reclining behind mosquito nets on four double-deck bunks, one against each wall, were cocked toward the speaker. Alongside the two barrack bags, rifles, steel helmets and gas masks beside each bunk hung the flyers' jackets bearing the insignia of the India-China Wing of the Air Transport Command. The only light in the hut was from a lantern suspended from a pole under the thatched roof.

Soon a singsong voice from Tokyo came through the scratches on the radio:

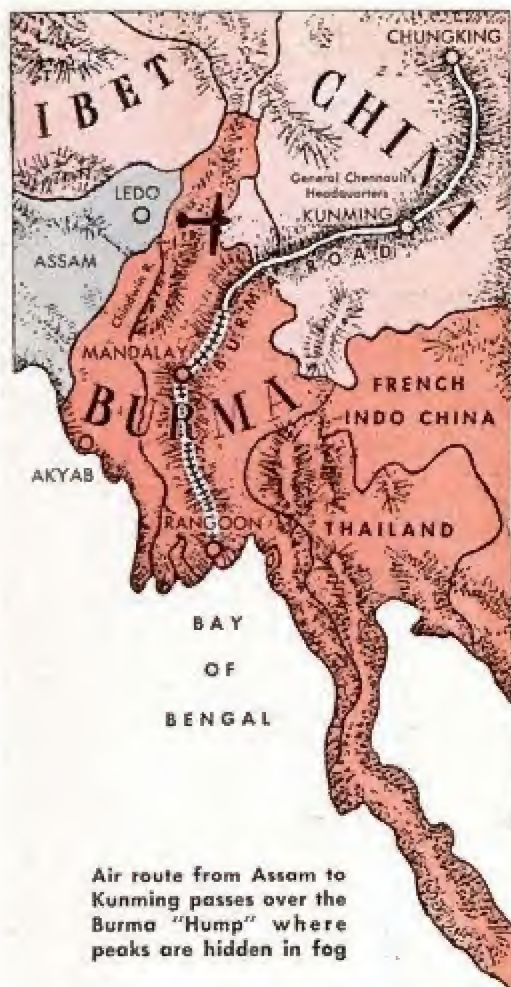
"Yesterday Imperial Japanese bombers in great force from advanced base Myitkyina in North Burma . . . (scratch, squeak) . . . thousands of tons explosives on American airfields in Assam . . . American cargo planes all burn . . . China Wing of

Air Transport Command wiped out . . . smoking ruin."

The guffaws of the men who fly the most dangerous air route in the world spread from hut to hut, from airfield to airfield in the network of bases in Assam, northeast corner of India between Tibet and Burma.

Tojo was always good for a laugh. The truth was that Jap bombers had dropped a few "eggs" on an airstrip yesterday and destroyed several cargo planes, but that was about the extent of the damage. And today—here was the joker—the commander of the "Hump" sector had sent out the largest tonnage of supplies that had ever been flown in a single day from India into China.

The amount of tonnage that went over



Air route from Assam to Kunming passes over the Burma "Hump" where peaks are hidden in fog

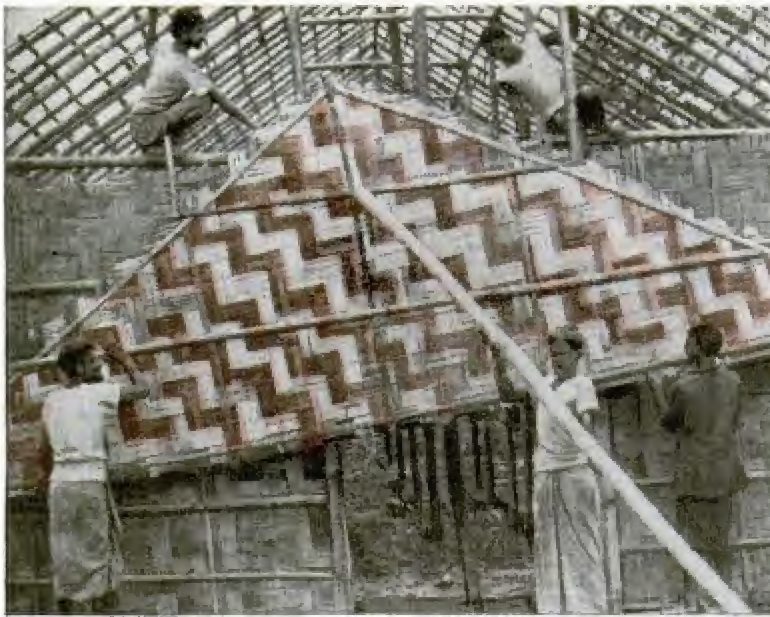
the Hump that day is a secret, just as it is every other day. But it can be revealed that the number of planes leaving the airfields of Assam daily for China is greater than the flights that come and go at La Guardia Field. The India-China Wing today is the biggest single air transport operation in aviation history and its monthly tonnage of military supplies is greater than was ever carried by trucks over the old Burma Road.

Since the fall of Rangoon in March, 1942, and the closing of the Burma Road, this air line has been the only supply route to Maj. Gen. Claire L. Chennault's 14th Air Force in China and the armies of Generalissimo Chiang Kai-shek. Critical cargo flown over the line includes aviation gasoline, ammunition, bombs, jeeps, trucks, artillery, small arms, airplane motors, spare parts, food and clothing. Ev-



Loading ingots of tin on a Curtiss C-46 at Chinese base for the return trip to India. Below, air view of Burma Road held by Japs

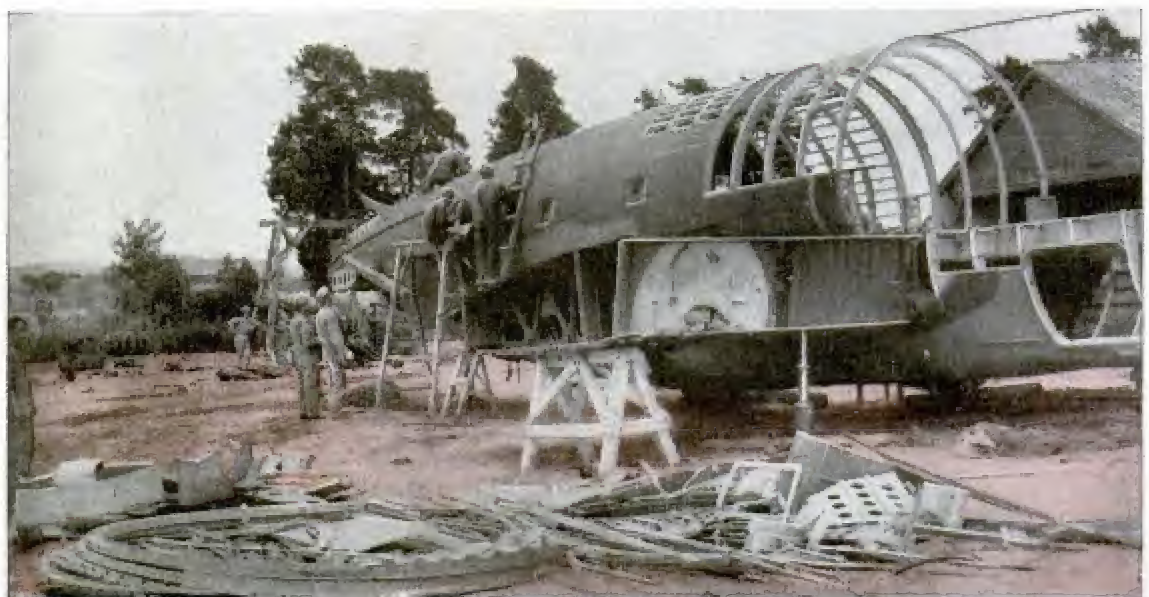




Natives erecting basha of cane strapped to bamboo poles to house Yanks



Water buffaloes help surface parking area near airstrip by pulling crude roller. Below, Chinese mechanics rebuilding C-46 at open air "factory"



ery gallon of gasoline delivered costs about \$20, and it takes three plane loads of fuel to put one heavy American bomber into the air for one raid on Jap positions.

The Hump route from Assam to Yunnan is 500 miles long, and veteran flyers say that every mile is a gamble with death. It gets its name from the subsidiary ranges of the Himalaya Mountains that extend into Burma, jagged snow-capped little brothers of Mount Everest that protrude into the clouds and mist at 18,000 feet.

Between the peaks are valleys of lush jungle and treacherous air currents which cause a plane to drop a couple of thousand feet in a minute.

In the so-called winter months, the Assam lowlands are covered with fog through which the planes must find their way down. During the monsoon season, from March to October, there is a steady downpour of rain, and the "ceiling" during this period is seldom higher than 3,000 feet. Icing starts at 15,000 feet. Planes sometimes have to fly as high as



Wing of C-87 shades laborers at lunch. Right, red ball is run up pole as air warning

30,000 feet to get over the "weather." Clear weather is a hazard, too, for the big unarmed transports are then more easily spotted by the Japs. And to further complicate the pilots' problems, the mountains deflect radio beams dozens of miles.

This deflection of beams and an accompanying gale resulted in an unscheduled visit to "Shangri-La" by one of the crews. Their C-87 (converted B-24 Liberator) flew in snow and darkness for hours after losing radio contact with the base. When there was no gas left, the crew of five men bailed out and found themselves on a snowy peak in the forbidden land of Tibet. Flight Officer Harold J. McCallum later reported they were so close to the mountain when they left the plane that the parachutes barely had time to open.

Three of the men land-

Filling rice bags to drop on remote stations in the hills



ed near enough to find each other by shouting above the whine of the blizzard. At daybreak, they were joined by the fourth member of the crew. The fifth man spent three nights alone. He lived on chocolate bars and quenched his thirst with snow.

Natives led the pilots to a village where an English-speaking Bhutanese monk lived. He housed them in his mud hut and contacted the Tibetan





Early morning scene—native livestock sleeps under ships. Left, loading tin

Teamwork by crew members of the India-China Wing is as highly developed as it is on the bombers that shuttle over Europe, according to Chaplain (Major) John S. Garrenton, who recently returned after 22 months in Assam. Major Garrenton has flown over the Hump 32 times. He tells how the loyalty of one 17-year-old radio operator, a corporal, saved the life of his crew chief.

"The C-46 in which they flew was attacked by Japs who suddenly dropped out of the

foreign minister who sent out a party to bring the flyers to the holy city of Lhasa. The minister arranged for a party to take the flyers by horseback to India. It took weeks to make the trip along narrow trails that wound among 25,000-foot peaks. After a short rest, the crew was back on the job.

Many of the men who have to bail out over the Hump, or survive a crash, find their way back to India. When a crew is in trouble, its position is radioed back to the base. A rescue plane flies out, locates the lost flyers and drops them supplies by parachute. If immediate medical aid is needed, a flight surgeon bails out.

clouds," he said. "A burst of gun fire swept the cargo plane from nose to tail. The pilot and co-pilot were killed. The left engine was shot out and the right engine set on fire. The plane plunged from 17,000 feet in a mass of flame. Neither the young corporal nor the crew chief could jump because they were pinned to the floor of the



Splattering mud and water, a C-87 takes off for "Hump"

burning ship by some heavy cargo that had broken loose.

"When the ship crashed in the jungle, it burst open and the two men were thrown clear. The corporal had only a few cuts and bruises, but the crew chief had a broken back and could not move. Placing water and food by the injured man, the corporal walked three days through the jungle to find help. He returned with native stretcher bearers and helped carry his chief to a village. There he sent up signals until a rescue plane was sent with a doctor who bailed out and remained with them all the way to a hospital in India."

Veterans of the Hump like to tell about the "early days" of the wing which started out with a few dilapidated DC-3's "that no respectable airline in the States would ever let leave the ground." That was in April, 1942.

The men operated from a single-strip airfield constructed by native labor in what had been a tea garden.

"That was some tea party," one pilot reminisced. "We loaded our own planes in those days. Spare parts were as scarce as mechanics. Delicate equipment that goes back to the factory in the States was ripped apart and repaired on the line. Sometimes a line chief would work 72 hours at a stretch."

An old radio was rigged up and made to serve as a communications center. There was a shortage of oxygen masks. The old DC-3's were not built for high altitude operations, but that didn't stop them. The pilots did their own navigating with 20-year-old maps and an "array" of instruments that consisted of one compass. Before the planes could take off, water buffaloes and curious natives had to be chased off the field.

Hugging the clouds to avoid Jap planes, flying down valleys to get around lofty peaks they couldn't fly over, fighting unpredictable air currents, ice or fog, this band of men kept a trickle of supplies flowing into China during the dark months of 1942. Late that year the Hump route was turned over to the Air Transport Command and things began to hum.

In February, 1943, 2,600 tons of supplies were flown into China. More pilots and better planes were added to the line, including a new Curtiss Commando (C-46). The Commando can carry three jeeps or an equivalent weight of artillery. Then came the freight-carrying Liberators with their 10-ton cargo capacities. Last fall, regular night flying was inaugurated.

Airfield after airfield was hastily constructed. Before the outside world knew what was happening, northeastern Assam

U. S. Army's "Brief Case" Gun Is Quick-Firing Weapon



Small but deadly, the United States Army's new "brief case" machine gun is a compact weapon the Yankee soldier can sling into position quickly. The .45-caliber weapon, which is sighted from the shoulder, fires as rapidly as the trigger is pressed and pops its spent shells into the air.

Compressed Air Fed Into Mask Guards Welders From Fumes

Protection against illness caused by fumes, a hazard faced constantly by welders, is a feature of a new mask worn at the Pullman-Standard Car Mfg. Co., in Chicago. A small hose is attached to a compressed air unit which fits inside the hood and directs the spray of air about nose and mouth. This prevents sweating and soiling of the eyes and stops fumes from being drawn into the welder's lungs.



Continued to page 156

*Backless Metal Products Corp.
31 Wintthrop Ave., New Rochelle, N.Y.
Magnifying Glass: May 1934, No. 29, p. 11, N.Y.C.
71857
0139*

Spring Clips for Flexible Tubing Stop Vibration and Chafing



Flexible tubing and hose are held in place with fasteners consisting of a conical spring ending in a clip. They absorb the vibration by permitting the tube to move in all directions, and provide for expansion without breaking the line. They are easily mounted with a screw at the base of the spring. At corners where tubes are bent at right angles, the clips prevent chafing.

Magnifying Glass on Headband Aids Laboratory Workers

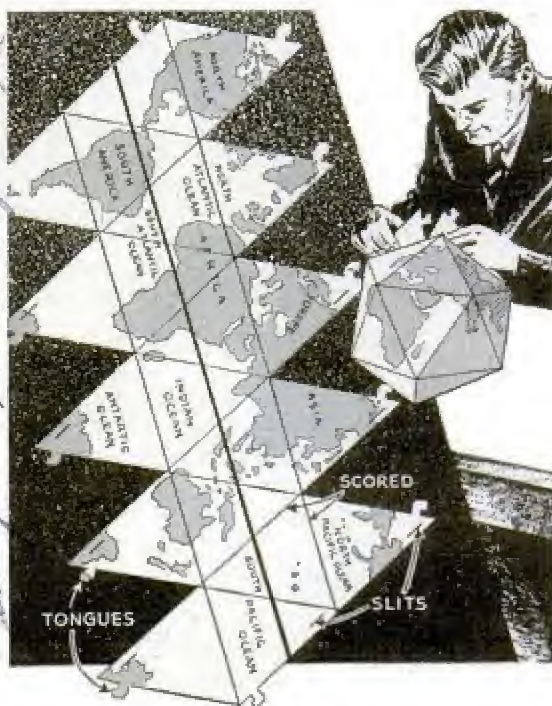
For the convenience of medical men, nurses, laboratory technicians, and indus-



trial inspectors, the optical industry has devised a set of magnifying lenses which are mounted on a band worn around the head. The band includes a small extension which permits the magnifiers to be pushed up out of the line of vision when not in use, thereby conserving valuable time. The set can be worn comfortably over spectacles, if necessary.

Flat Map Distortions Reduced By Forming 20-Sided Solid

Prof. Irving Fisher of Yale University has invented a world map to reduce the distortions in flat maps. Made up of 20 triangles of equal size, it can be folded into an icosahedron, a 20-sided solid resembling a globe. One advantage is that it is harder



to transfer a great circle route from a globe to any flat projection than from an icosahedron to Prof. Fisher's flat projection. Flattened out, the map can assume many forms, including the grouping of the land areas in which the war is now being waged by using only six of the triangles. It is possible to arrange the map so it can be built up or flattened out merely by pulling a string. Needle and thread or slits and tongues can be used to keep the icosahedron together.

☐ You can obtain additional information about products described in this magazine by writing to the firms listed in the Where-to-Buy-It index. Say You Saw It in Popular Mechanics.



The CRAFTSMAN

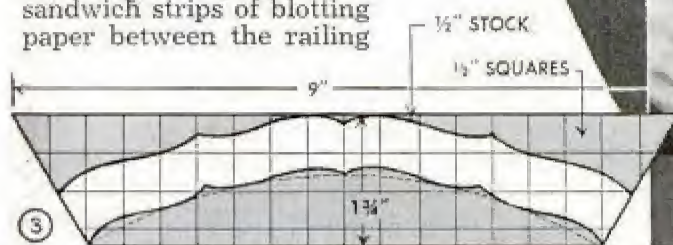
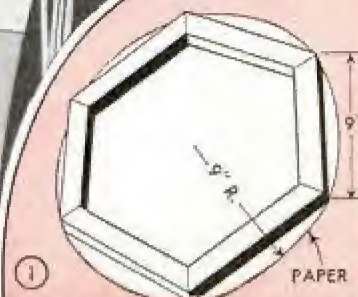
Lightweight

BEVERAGE TABLE

carried with ease

FOR A FEW cents worth of material you can make a novel refreshment table that will be an ornament to your living room as well as a useful piece of furniture. Made of light wood glued together, it may be carried easily about the house in place of the server generally used, and will stand firmly on its four legs. The tray is made of a solid piece of $\frac{3}{8}$ -in. board cut to the size shown in Fig. 1. On this tray six pieces of $\frac{1}{2}$ -in. stock are glued to form a railing so that beverage glasses will not slip off.

The railing pieces are fashioned to the overall dimensions shown in Fig. 3. Each end is cut at a 60-degree angle, after which the pattern is outlined carefully as shown in the light area. A piece of cardboard or tin can makes a good pattern for outlining the design, as illustrated in Fig. 2. Before gluing the sections to the tray board, sandwich strips of blotting paper between the railing



by
Charles and Bertram Brownold

JULY, 1944

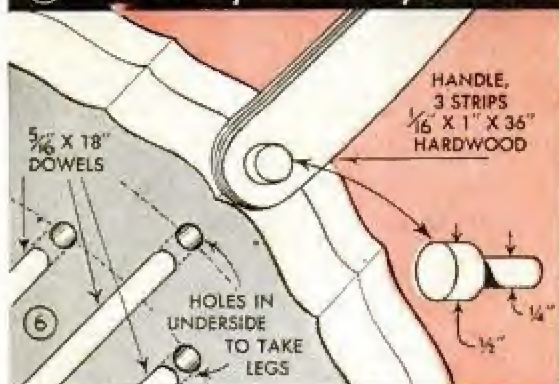
89



④ *Railing pieces sanded*



⑤ *Handle pieces clamped*



⑦ *Wrapping ends of legs*

and tray so that you can take them apart when you are ready to cut the inner line of the design on the railing sections. Now, with the railing and tray glued together over the blotting paper, cut the outer line of the design with a jigsaw, band saw or coping saw. Before separating the pieces, however, be sure to mark all parts so that later they may be reassembled in the same positions, because no matter how carefully you cut the design, there will be small discrepancies which will show up if the pieces are not replaced as they were when cut.

Sand off the blotting paper, cut the inner line of design on the railing pieces and round off the sharp edges with emery cloth as shown in Fig. 4, so that the edges will hold the finish paint or enamel. The pieces are now ready to be glued back on the tray. Another method that can be used just as well is to cut out the inner line of design on the railing sections, next glue them permanently to the tray, and then cut the outer line of design through both railing and tray.

The handle consists of three strips glued together in the jig illustrated in Fig. 5. As soon as the glue dries, the handle may be attached to the tray by wood pegs shown in Fig. 6. These are turned to shape or made by gluing pieces of $\frac{1}{4}$ -in. dowel into buttons of $\frac{1}{2}$ -in. dowel drilled to receive them. The legs are located on the tray bottom by marking off four triangles with sides $2\frac{1}{4}$ in. long pointing outward. Drill a blind hole at the corners of each triangle and glue in the leg dowels, as in Fig. 6. The ends of the legs are lashed together with linen fishline, Fig. 7, and then coated with varnish.

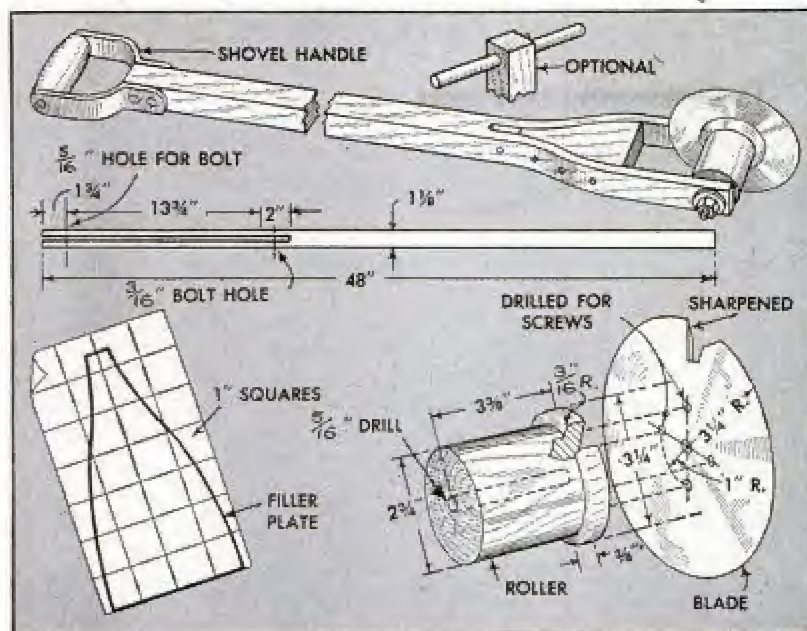
The table may be left in natural finish by sanding and varnishing, or painted to match other furniture. Beautiful effects may be achieved by antiquing the edges of the railing or by shading them slightly to set them off from the base color.

Cutting Velvet and Jersey Cloth When Using a Pattern

When cutting velvet, jersey and similar fabrics to a pattern for making garments, avoid pinning the cloth and pattern together. If this is done, the cloth may slip ahead of the scissors when cutting it and cause the cut piece to be of inaccurate shape. Instead, lay paper weights or other small objects on the pattern and material to keep the pattern in place. Then mark the outline of the pattern on the cloth and cut the latter to shape. This eliminates slipping of the pattern. However, if the cloth is cut doubled, the two thicknesses of cloth should be pinned securely together.

—Gladys M. Burrell, Chicago.

Lawns Trimmed Evenly by Simple, Fast Edger

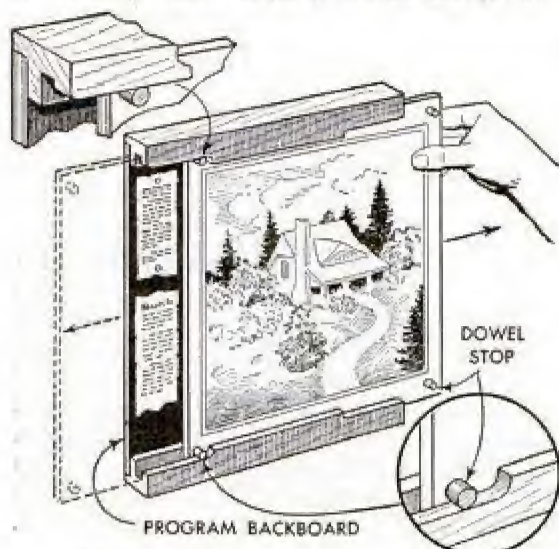


Trimming lawns at uniform depth and width is accomplished with this speedy edger featuring a spacing roller turned from a maple block. The shaft is a piece of oak or other straight-grained hardwood. First drill the bolt holes, then slit about twice saw-blade thickness. To prevent splitting the shaft, insert upper bolt before attaching filler plate. Steaming will make the tough wood pliable. Cold-rolled steel or galvanized sheet of .065 gauge may be used for the blade, which is filed to a cutting edge.—J. S. Sawyer and E. Drewitz, Woodside, L. I.

Household Data Sheets Hidden Behind Sliding Picture

Daily radio programs and other household data can be kept handy for easy reference, yet hidden from view, by concealing them behind a sliding picture. The picture is mounted on a panel of plywood or hard-pressed board, which slides be-

tween two pieces of wood grooved and screwed to a second panel. This panel is screwed to a wall and should be of fir plywood or wallboard into which thumbtacks can be pushed easily. Short dowels at the four corners of the picture panel serve as stops to prevent the panel from being pushed too far to either side.



Ink Reservoir for Writing Pen

A pen will hold an extra supply of ink if a narrow, pointed strip of celluloid is slipped under the nib and held by friction in the penholder. In this position, the strip forms a reservoir to retain the ink.



☞ A few drops of glycerin on a dried stamp pad will help to restore its freshness.

Latch String Opens Flaps of Tent And Holds Them Out of Way



Instead of propping or tying open the flaps of your tent for convenience in passing in or out, stitch a couple of rings to the sides, drive a screw eye in the pole, near the ridge and a screw hook farther down. Thread a doubled length of stout twine through the screw eye, pass the ends through the rings and tie these onto the tent flaps by knotting them through the lace eyes provided. A little experimenting will indicate the proper length of the twine and position of eye and hook. Release of the looped twine permits the flaps to close.

Crochet Hook Opens Wrappers Safely and Quickly

In offices where a number of wrapped newspapers or magazines must be opened in a hurry, a crochet hook will serve the purpose much better than a knife or razor blade. The hook is used as shown to cut the wrapper without damaging the contents or endangering the user.



Foot-Pedaled Catamaran Doubles as Sailboat

It's great fun to lie on the deck of this homemade catamaran, slip your feet into the toe-clips and paddle over the lake or bay, steering your course by the forward rudder with no effort at all. The pontoons, of $\frac{3}{4}$ -in. lumber, are joined with nails—preferably galvanized—driven about an inch apart, and are caulked with strips of cotton binding-tape laid in marine or casein glue, or white lead. Plywood centerboards are screwed on the inside of each pontoon.

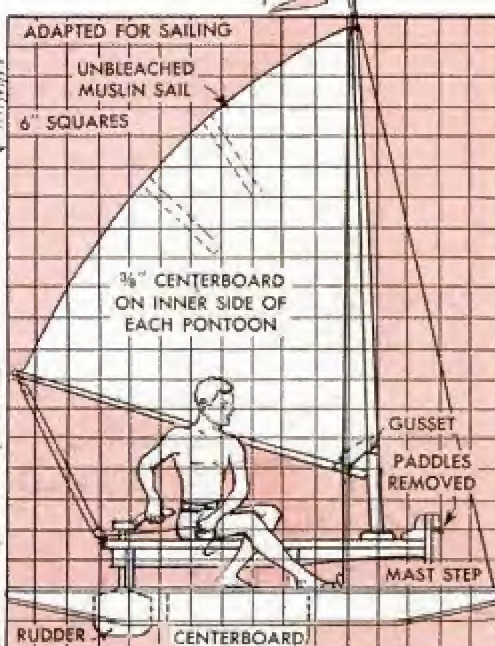
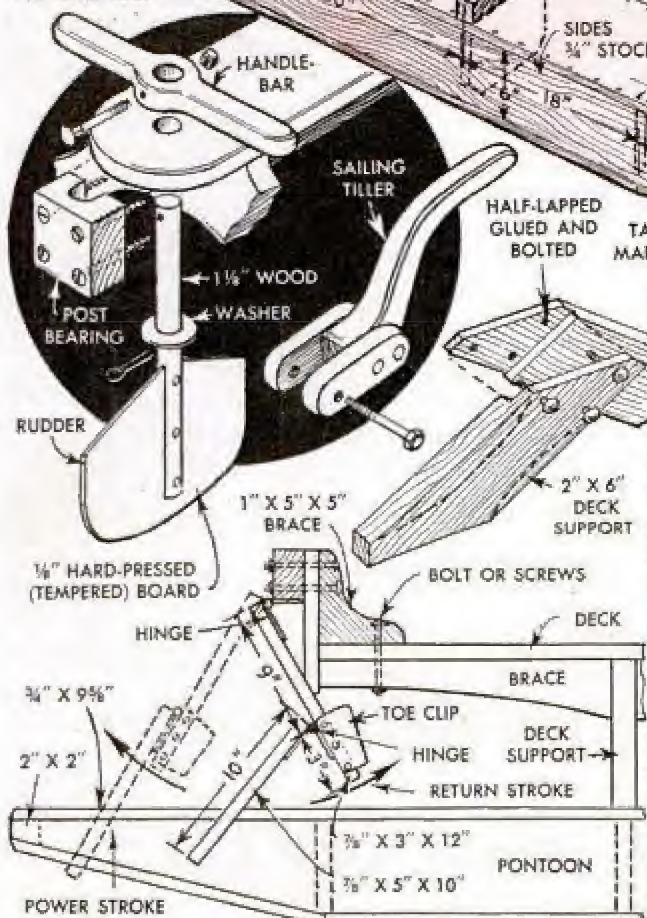
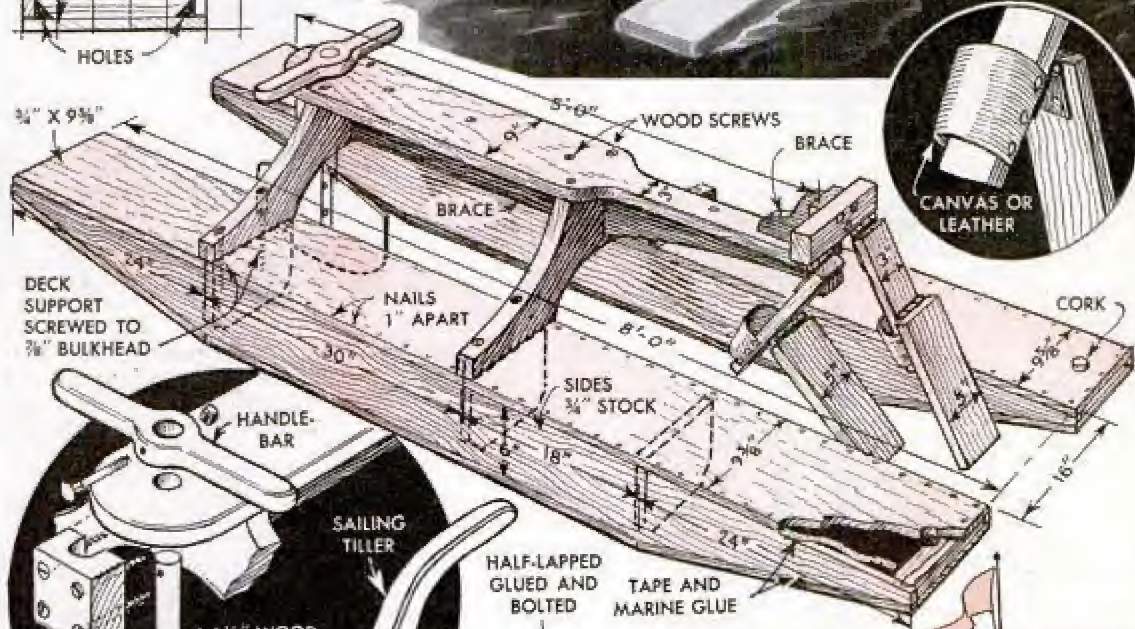
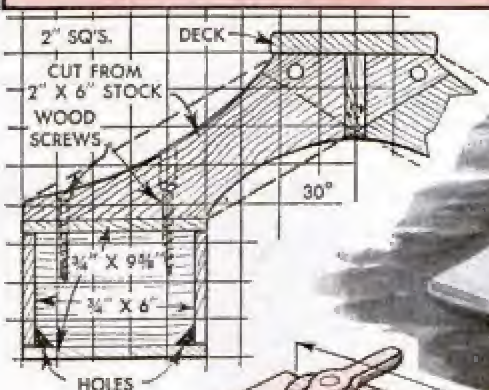
The deck, made from the same material as the pontoons, is supported by two arched cross-members of 2-in. lumber cut as shown and half-lapped, glued and bolted together and installed on the pontoons with screws through the two forward bulkheads. A brace running under the deck reinforces it. A stiff crosspiece supports the paddles a few inches above deck level, and on this piece the paddles are hinged. On the drive stroke the paddles swing back against the upper section to which the canvas or leather toe-clips are attached, and on the return, they swing free, dragging across the surface of the water.

To use the catamaran as a sailboat, the paddles are fastened out of the water, the handgrips are removed from the rudder and a tiller is substituted. The skipper now faces in the other direction, with the rudder at the stern. The mast, tapering from 2 in. at the bottom to $1\frac{1}{2}$ in. at the top, is held in a step block on the narrow part of the deck and braced by wire stays made taut with turnbuckles. To furl the sail, the boom is swung up and the sail wrapped around the mast and tied. Several coats of paint carefully applied complete the job and give you a sea-worthy boat that can be used for a diving platform, surf board or craft for an outboard motor as well as a foot-powered raft.

Easy Way to Clean Your Watch

If a watch needs cleaning because the works have become gummed slightly, often the job can be done without taking the watch apart by applying a few drops of carbon tetrachloride to the works. This chemical is one of the best solvents known for grease, which combines with dust to cause the gummed condition. The solvent is very volatile and will evaporate quickly.

Fun at the beach with this KICK-KATAMARAN





Solving HOME

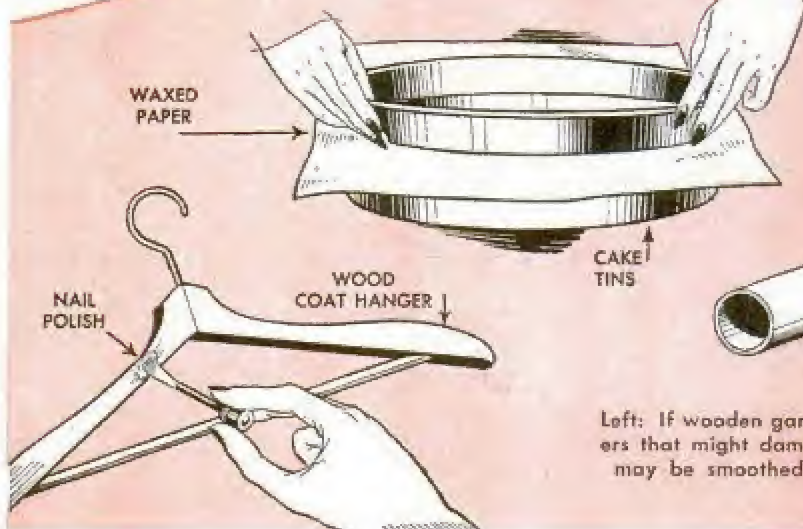
Left: Mesh dish cloths with poultry markers attached to each corner make convenient bags which will not snag hose and will hold a number of other small laundry items when hung out of the way on a hook. Below: A potato masher of the type shown will hold a recipe file card so that it can be seen easily while in use, and also keep it clean

Hemming or basting may be done more easily and quickly if the material on which you are working is pinned to a pillow held on your lap, thus leaving both hands free to work. As much as 16 in. of material can be basted without moving the pin



Below: A cleaning stick to scour hard-to-reach places in pots and pans can be made by pushing a small wad of steel wool into the end of a metal tube, the end of which is flattened to hold it

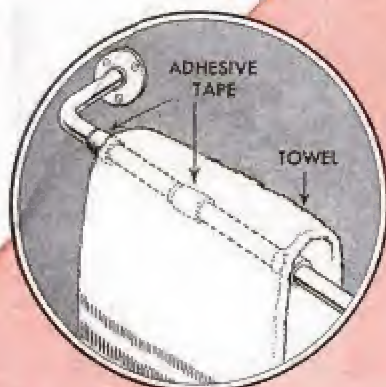
When waxed paper is used as a lining in cake tins, the paper may be fitted by placing it on a warmed tin and using another as a die to force it into place



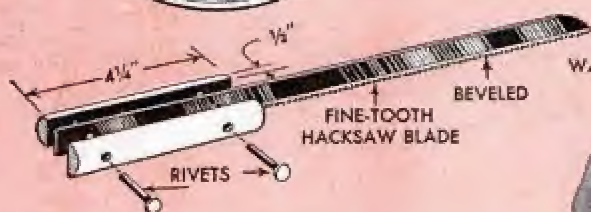
Left: If wooden garment hangers have cracks or splinters that might damage coat linings or dresses, they may be smoothed by a coat of fingernail polish

PROBLEMS

Right: When hanging doors with butt hinges, insert only the center screw in the part of the hinge on the casing. Then, in fitting the hinges, a little tapping up or down will seat the hinge properly and will make the pin fit without binding, after which the rest of the screws can be inserted. Below: Strips of adhesive tape on the bar of a towel rack prevent the towels from slipping off



Placing a small washer under the loose end of a roll of friction tape will allow the end to be lifted easily, which is more convenient than turning under part of the end



Above: A useful and inexpensive knife that will cut bread to "wafer" thickness and also is good for cutting cake can be made from a small, fine-toothed hacksaw blade which has been ground on the sides to remove the set of the teeth. For a handle, two wooden blocks of the same width as the blade are riveted to it. Below: The next time a stubborn bottle cap refuses to come off, try removing it with an ordinary nutcracker



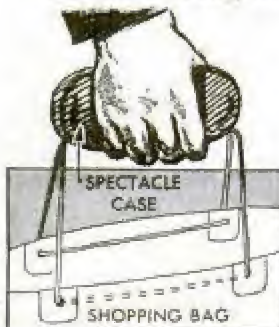
The danger of baby's slipping on polished floors and linoleum, due to the smooth soles of its shoes, can be lessened simply by sandpapering the soles, using a very coarse grade of paper to roughen them

Nails Pulled Out of Wood Trim Without Marring Finish



Old interior wood trim may be saved for further use if the nail heads are pulled through the board on the unfinished side. In this way, the putty or filler used to hide nail holes is not disturbed, or the finish marred in any way.

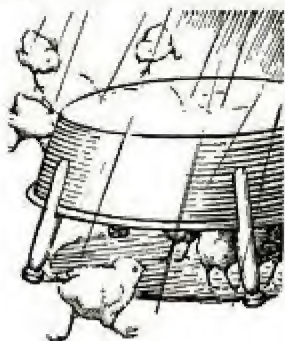
Old Spectacle Case Used as Grip On Handles of Shopping Bag



To provide a comfortable grip for carrying a shopping bag, one housewife employs a discarded metal spectacle case. The case may be left attached to one of the ropes so it is at hand when needed.

Inverted Pan on Clothespin Legs Makes Emergency Chick Shelter

When young chicks are left in an open pen and it is possible that they will not return to the brooder in case of a sudden shower, attach three or four clothespins to the edge of a tin pan and invert it



to provide an emergency shelter. Being open on all sides the shelter offers no obstruction to the entry or exit of the chicks, and they immediately learn to use it. Also, one or two chicks making use of the shelter may be seen by the others and thus be induced to take advantage of it.

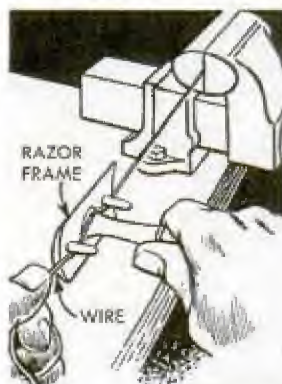
Emergency Stamp Pad

An old typewriter ribbon provides a good substitute for a rubber stamp pad in an emergency. Wrap several layers of the ribbon around a heavy piece of cardboard



cut to fit inside a small tin or cardboard box. When the stamp no longer gives a clear impression, the outer layer of ribbon can be removed to expose the next layer.

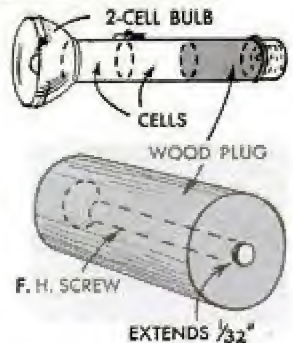
Small-Gauge Wire Straightened With Discarded Safety Razor



Fine wire that has become kinked can be straightened with an old safety razor of the type shown. Just grip one end of the wire in a vise, thread it through the frame of the razor as shown, and then pull the razor along the wire.

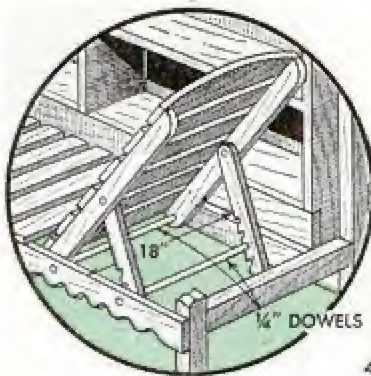
Converting Three-Cell Flashlight For Use With Two Cells

Anyone having a flashlight that requires three or more cells can effect a saving by converting the flashlight to operate on only two cells. I did this by substituting wood plugs for all cells over two and using a bulb suitable for two cells in place of the larger one. The plugs are turned to the shape and size of a cell, and have long flat-head screws running through their centers as indicated to complete the electrical circuit.

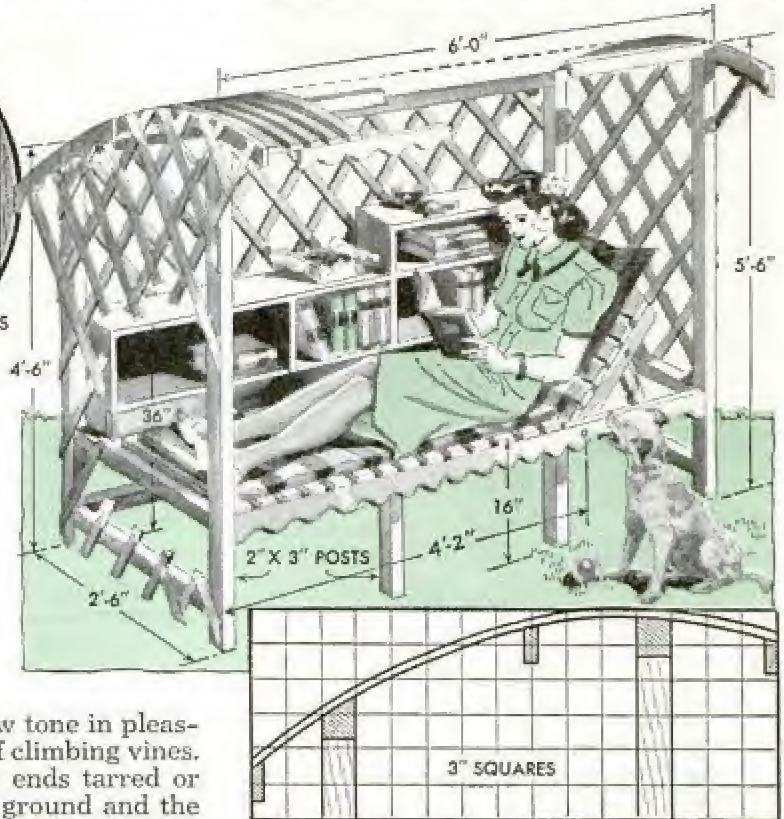


—O. A. Neumer, Jr., Lawrenceville, N. J.

"Vest-Pocket" Summer House for Your Siesta



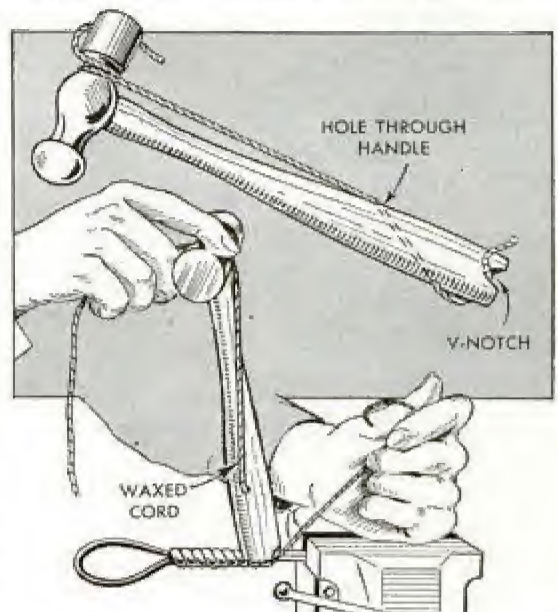
Containing many comforts of home, this cosy little shaded arbor has a couch with adjustable back and shelves for books, magazines, radio, smoking equipment, etc. Since it is exposed to the weather the year 'round, the arbor can be constructed of used lumber, which will take on a mellow tone in pleasing contrast to the foliage of climbing vines. Four posts with the lower ends tarred or creosoted, are set into the ground and the structure built on them. The diamond-pattern lattice on three sides serves as bracing, and light battens are installed on the top. Box shelves are built in the conventional manner, and the adjustable back of the couch is held in the desired position by racks engaging with a stout dowel.



Scrollsawed wood valances are nailed over the lattice at the eaves and along the seat. A pad for the couch can be made from heavy cloth and then padded with cotton or other suitable material. Quilting the pad will keep the cotton from bunching.

Hammer Used as Aid in Wrapping Small Lacing Cord

When lashing down a finished splice or line with waxed cord, use of a hammer handle as shown improves the job and makes the work easier. A V-notch is cut across the end of the handle to receive the work, after which the lashing cord is fed through a small hole drilled at a steep angle near the notch. By bringing the cord up and taking a turn or two around the head of the hammer any desired degree of tension can be applied.



Seeds Keep Well in Glass Jars

Store flower and garden seeds in glass jars to protect them from mice, and treat them with a few drops of carbon disulphide to prevent spoilage. The jars also make it easy to label the seed, giving the age and type. Glass jars for seed storage will enable you to keep tomato and other seeds for more than one season and help you to accumulate a wide variety.



"Nursing" Your

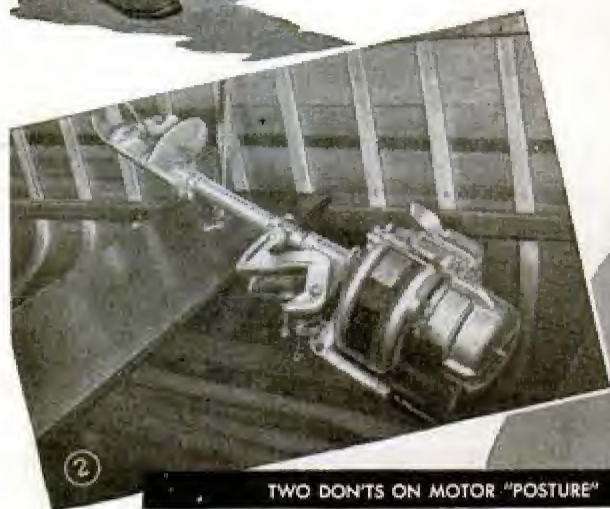
How to use and care for an outboard motor to give it long life

By C. E. Packer



WITH many outboard motor parts no longer available, unnecessary wear or damage to these little power plants becomes more than a personal inconvenience. Many of the actions most harmful to a motor often seem innocent enough. For example, a person who is most careful with his motor when carrying it in a car, may stand it on the tank and flywheel to be sure that it is held firmly as in Fig. 3. In this position, any water in the lower housing is likely to drain into the cylinder where it may cause serious damage. Sometimes you see a motor stored in a boat as in Fig. 2. The power unit being lower than the propeller in this position, is in danger of cylinder rust, piston corrosion, and wrist-pin injury. Of course, padding the engine or tying it securely to prevent bouncing around is essential, but keep the power unit higher than the propeller end.

One of the greatest single causes of trouble with an outboard motor is carelessness in mixing the fuel and oil. Even those who know better frequently trust to luck that vibration will



TWO DON'TS ON MOTOR "POSTURE"

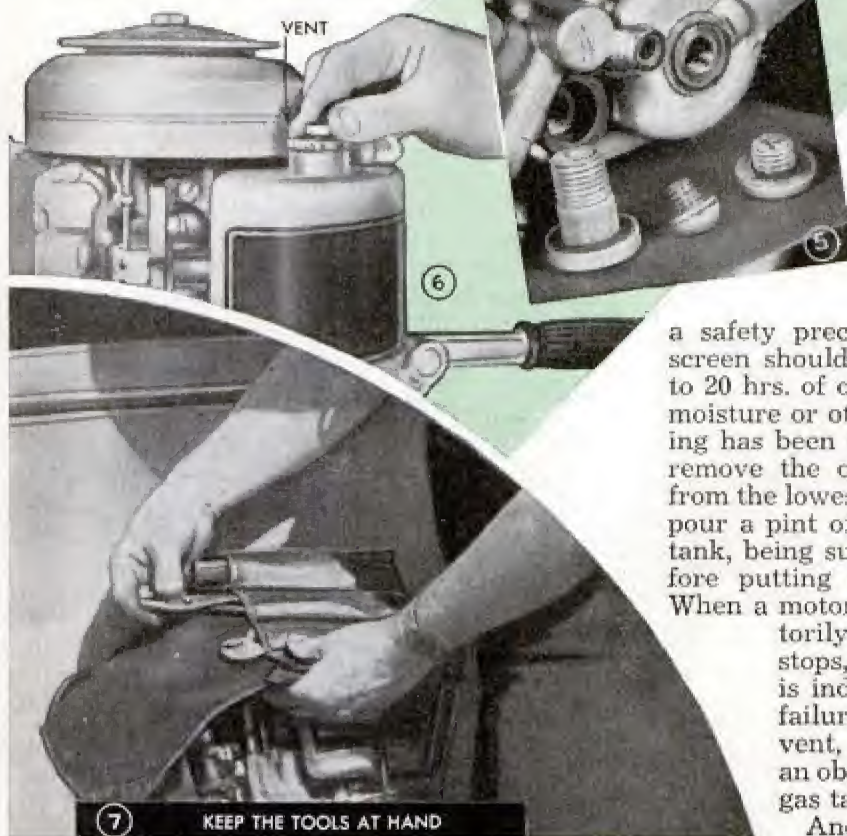
Outboard



blend the oil and the gasoline. If the gasoline and oil are not mixed thoroughly, gasoline alone may enter the motor and cause extremely rapid wear. Oil alone will make starting impossible. Therefore, it is best to mix the fuel in a clean container, such as the special outboard fuel can seen in Fig. 1. The small passages through which the fuel must travel are seen in Fig. 4. As the tiny strainer



4 KEEP GAS LINE CLEAN



7 KEEP THE TOOLS AT HAND

screen shown on the pencil in this photograph handles the fuel and oil for a 5-hp. motor, it is apparent that a few tablespoonfuls of either oil or gasoline entering through the gas lines or carburetor bowl without being properly mixed may cause serious results. As

a safety precaution, the drain plug and screen should be removed after every 10 to 20 hrs. of operation and cleaned of any moisture or other foreign matter. If starting has been difficult, it is a good idea to remove the other screws seen in Fig. 5 from the lowest parts of the carburetor and pour a pint of clean gasoline through the tank, being sure to shake all of it out before putting the screws back in place. When a motor starts easily, runs satisfactorily for a few moments, and then stops, faulty gasoline flow usually is indicated. This may be due to failure to open the gas tank air vent, Fig. 6, or it may be due to an obstruction in the bottom of the gas tank, or in the gas line.

Another thing to remember is

Hints on how to use outboard motors



⑧ FORCING PLUGS STRIPS THREADS



⑨ GRAPHITE ON PLUG THREADS

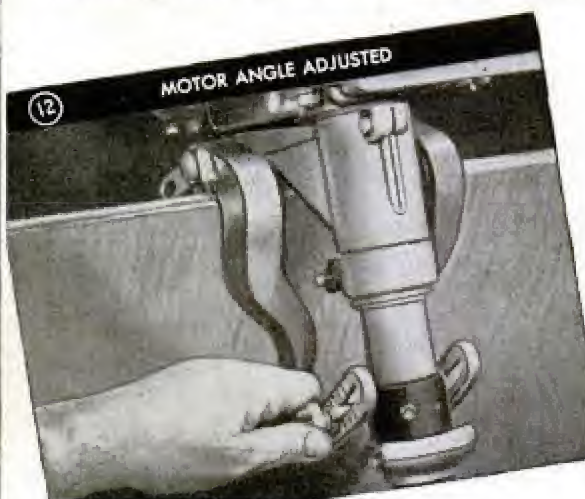


⑩ CORRECT POINT SPACING



⑪ CHECKING COMPRESSION

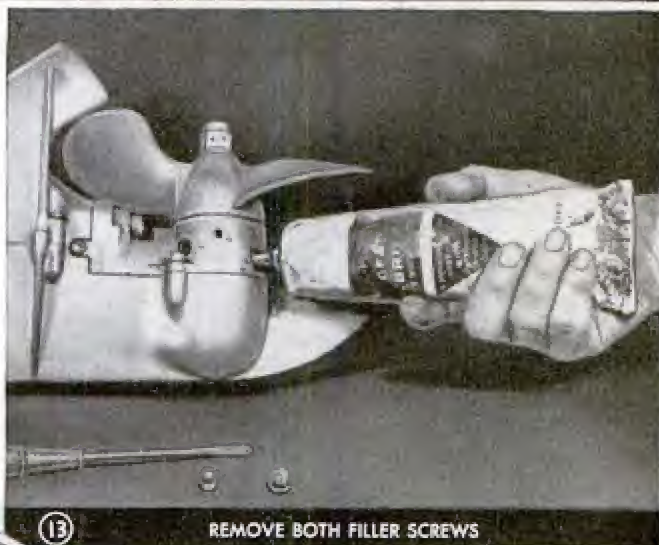
always to have the outboard tool kit aboard when under way, Fig. 7. Extensive damage to the motor often results when odds and ends of tools are resorted to in making repairs. Using pliers on the soft aluminum fittings of the motor may damage these parts so that they are useless. And, resorting to too large a wrench, Fig. 8, when installing spark plugs may strip the threads in the cylinder head. Perhaps the best protection against injury to the threads is to apply powdered graphite to the plugs before putting them in place, Fig. 9. This keeps the threads from seizing and makes the plugs screw in easily. Whenever replacing plugs, new gaskets should be used if available, and the plugs should be pulled down just tight enough so that the gaskets are noticeably compressed though not crushed. Failure to pull the plugs tight may cause them to burn. This results from gas escaping around them and raising the temperature above that for which the plugs were originally designed. In addition to this, there is a reduced transfer of heat from the plugs to the water jacket of the cylinder head. This combination teamed up in a high-speed motor can cause total plug failure in a short time. Of course, many motors are used at a lower rate of speed than formerly, trolling by the hour where permitted. Consequently, the selection of proper plugs introduces a new problem. One motor manufacturer advocates reducing the amount of oil in the fuel when the motor is used for trolling, which brings up the problem that one may troll for a period and then, finding results unsatisfactory, "give 'er the gun" and run over to another portion of the lake. Naturally if the fuel is low in oil content, heating and wear may result. For this reason, operators



⑫ MOTOR ANGLE ADJUSTED

and the things that you should avoid

who know exactly how and where they intend to fish invariably reduce the oil content for long periods of trolling and keep their high-speed fuel and their trolling fuel in separate well-labeled cans. Then, on a run of 15 to 20 min. out to the fishing grounds, they will dump in just enough gasoline of high oil content to make the fast run, after which the tank is filled with gas of low oil content for trolling. However, it is a good idea to carry a few extra plugs. If a plug has an insulator that is



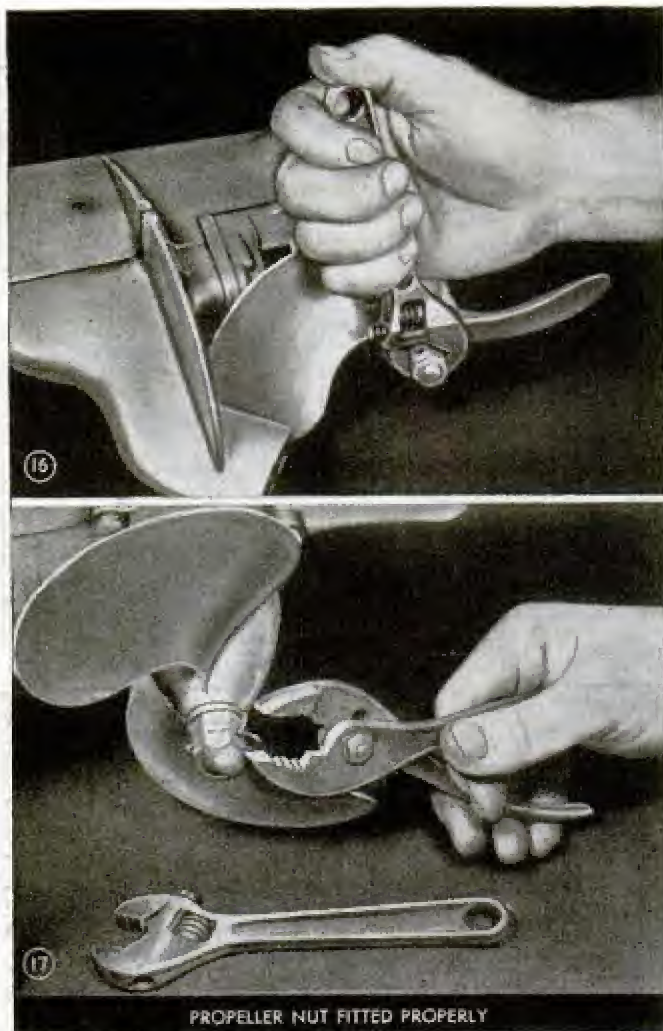
burned pure white, the plug is too "hot" for that particular motor or condition of operation.

Motors that operate satisfactorily at high speed may not run continuously and smoothly at low speed, due to slightly uneven compression. But for best results in any motor, absolutely uniform plug gaps set with a wire-type feeler gauge as in Fig. 10 will help. While the experienced operator learns to "feel" the compression of his motor by grasping the flywheel and turning it, still some operators measure the resistance by using their fish-weighting scale as in Fig. 11. In order to make comparable tests the motor should be warm and the oil mixture in the fuel should be

the same at each test period. On an alternate firing motor it is not necessary to remove a spark plug when making this test, though on a simultaneous firing (opposed) motor plugs of cylinders not being tested should be removed.

When operating a motor on different boats be sure that the drive shaft is vertical, or stands at right angles to the water when the boat is loaded. Failure to adjust the brackets seen in Fig. 12 may place the motor at a decided disadvantage in performance. Also, the lubricant in the gear housing should be checked, especially in smaller motors. Normally, grease should be added about every 20 hours of operation, though this will vary greatly in different motors depending on the tightness of the housing. When checking the unit, both upper and lower filler screws in Fig. 13 should be removed so that the housing will not be airbound. If there is any sign of water it should be removed and replaced by clean grease.

Perhaps the most common form of serious mechanical damage is caused by boulders or logs striking the underwater parts of the motor. Fig. 15 shows a gear housing from which the fin has been broken and in which two serious cracks have been caused by striking a submerged object at high speed. Even though the housing does not break as this one did, the drive shaft may be sprung enough to cause serious gear wear, as indicated by the gear in Fig.



14. If shear pins in the propeller persistently "let go" without the propeller apparently striking any object it is an indication that the flywheel is loose on the crankshaft and is imparting a violent rapping action to the propeller. When replacing shear pins it is important to pull the propeller nut up firmly, Fig. 16, yet not tight enough to strip the threads. The cotter pin used to lock the nut should be clipped off short and bent down as in Fig. 17. Any accumulation of seaweed on the lower housing or other obstruction to the flow of cooling water may burn up the motor. Due to failure of the water pump and lack of observation by the user, the motor may become overheated to the point where it loses power and stops. If this happens never turn the motor on end and let water run into the cylinders while they are extremely hot, and don't start the motor so that it will pump cold water into the hot cylinders. Instead let the engine cool off for about 30 min.

Engines operated in salt water should always be rinsed by running them in a barrel of fresh water before putting them away. Failure to do this may result in the complete eating out of all aluminum parts. Next month: **Outboard Maintenance and Repair.**

Simple Jig Aids in Edge-Beveling Boards With Hand Plane

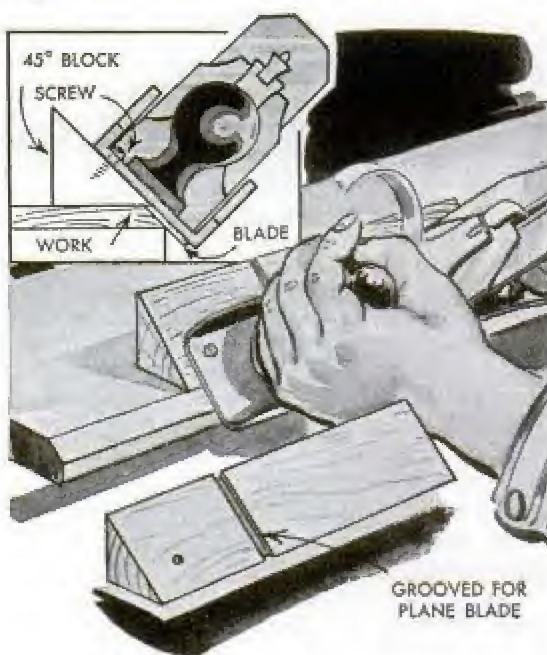
Having a number of boards on which the edges had to be beveled at exactly 45 degrees with a hand plane, I did the job easily with the aid of this jig. Being nothing more than a triangular wood block, the jig is screwed to the plane to cover half the blade as indicated, and thus hold the plane against the work at an angle of exactly 45 degrees. In this way, accuracy is assured and the beveling job is no more difficult than regular edge-planing.

—Warren L. Jannick, Chicago.

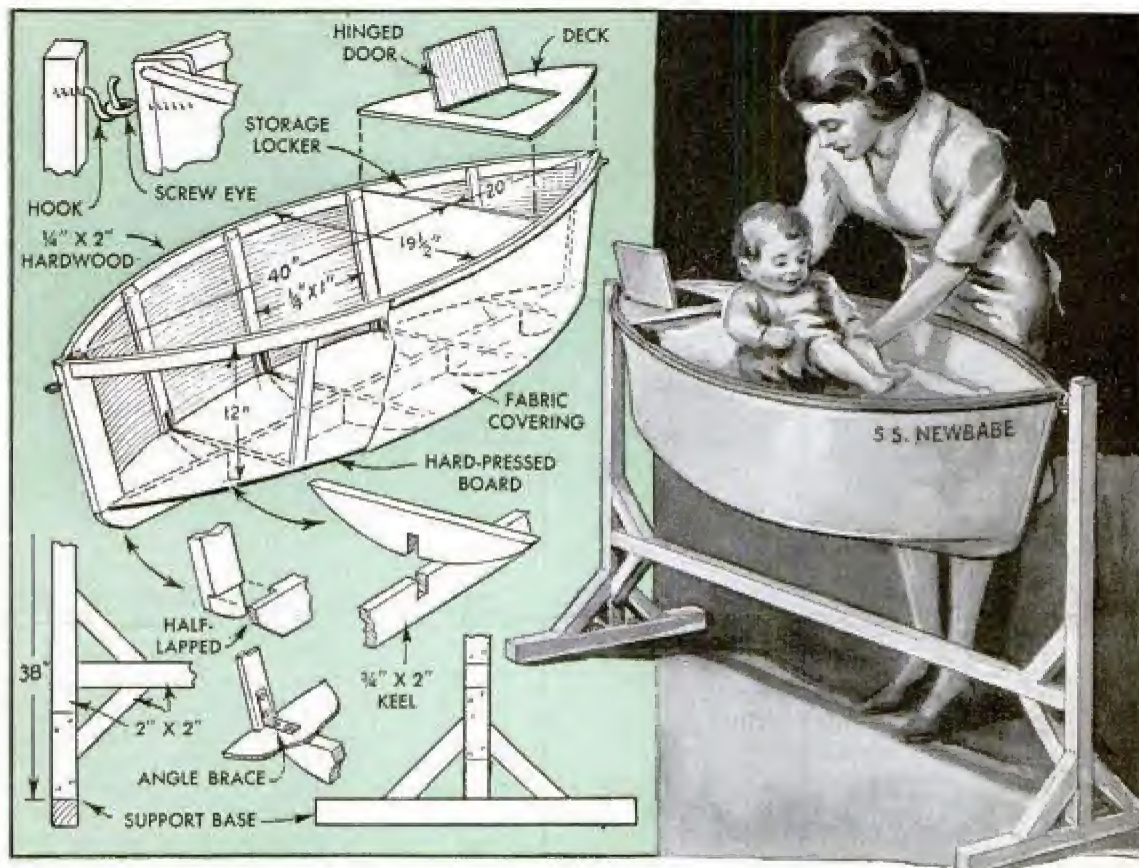
Preserving Leather Book Covers

Waxing the covers of leather bound books about once a year preserves them in much better condition. The treatment also benefits chairs, luggage and numerous other leather articles. Cover all but the parts to be waxed and apply a thin coating of liquid or paste wax. Let this dry slightly before polishing.

—Mrs. Hal Geihm, Aurora, Ill.



Baby's Boat Crib Has Storage Space Under Deck



The infant member of your family will sleep comfortably in this boat crib which you can assemble at a small cost, especially if scrap lumber is available. Supported at a comfortable working height for mother, the crib has a storage locker at one end to keep baby's most needed clothing conveniently at hand. After shaping the keel, stem and stern pieces, assemble them with half-lapped joints glued and screwed together. Next shape and notch the bottom crosspieces and fasten them to the keel with nails or small screws. Hard-pressed

board makes a strong floor, and a table pad will serve for a mattress. Stretch canvas, monk's cloth or some other sturdy fabric over the frame, tack in place and trim with half-round molding. The interior side surfaces can be padded with an old blanket faced with colored satin. If a pair of compression coil springs are available, these can be fastened at stem and stern and attached to the support-hooks. Two coats of colored enamel will make the cradle an attractive and unusual piece of furniture.

—Charles J. Lowe, Tracy, Calif.

Student Carries Ruler Easily in a Loose-Leaf Note Book

Student draftsmen and others who often have to carry a ruler as well as books and other items, will find that the ruler, or even a triangle can be carried easily in a loose-leaf note book. Just drill holes in the ruler or triangle so that it can be slipped over the rings in the note book as indicated.

—Richard F. Crocker, Worcester, Mass.

❏ If you carry several keys, painting the key and lock the same color, but using different colors for each different lock set, will enable you quickly to select the desired key merely by matching the colors.

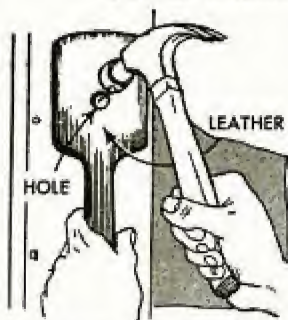


"Raincoat" Keeps Bandage Dry During Shower Bath



An efficient "raincoat" to keep bandages dry while taking a shower can be made from oiled silk or other water-repellent material. Sew together the ends of a strip of the material of suitable size. Make a wide hem at the top and insert a strong drawstring. This shield may be used to cover a bandage on the hand, arm or leg.

Leather Paddle Protects Wood From Hammer Marks



Since one mis-directed hammer stroke can mar the finish of fine wood in furniture repairing or similar jobs, some kind of a protector is needed. One of the best of these is a piece of leather cut in the shape of

a paddle in which a hole is cut sufficiently large to take nail heads. After the nail has been started the paddle is placed over it.

Cleaning Powder Removes Spots Of New Type Paints

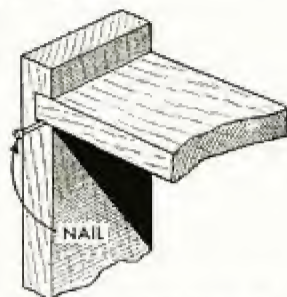
Splattering of some of the new type fast-covering wall paints on woodwork or other surfaces can be removed easily by rubbing with ordinary abrasive kitchen cleansing powder. The paint will come off even after it has been allowed to set for a long period. Such a method is more effective than razor blades or fine sandpaper.

Rugged All-Purpose Wagon Eases Home Chores

Built entirely of wood except for wheel spindles and bushings, this wagon will ease many of your home chores. Besides being ideal as a coaster for the children it can be used for bringing home groceries and merchandise or for collecting junk. With the "hayrack" in place, it will hold large quantities of grass cuttings, weeds, brush, kindling or magazines and newspapers. And, for the infant member of the family, there is a seat on a hickory spring that fits into a slot at the forward end of the wagon body. The corners of the wagon box are reinforced with sheet metal, and the rear axle and front bolster are braced with knees screwed on from the top. Slots are cut in the bottom of the box to receive the eight legs of the hayrack; another one at the front end accommodates the hickory spring for the baby seat. Wheels are $1\frac{1}{2}$ in. thick and 9 in. in diameter, each consisting of two $\frac{3}{4}$ -in. hardwood disks glued and screwed together with the grain running at right angles. The edges of the wheels should be beveled slightly to help prevent splintering. Machine bolts serve as wheel spindles on which the pipe wheel bushings rotate. An oilhole is drilled in each bushing to line up with one drilled at an angle into the side of the wheel. The latter hole is packed with cotton to retain oil and is plugged at the top to keep out dirt. For the baby-seat spring a hickory slat is steamed and bent to the shape indicated. The seat is pine and the curved back $\frac{3}{16}$ -in. hard-pressed board.

Finishing Nail Interlocks Joints In Door Jamb

Here's a trick one carpenter uses to interlock the joints when assembling door jambs. After nailing them together in the usual way, he drives a finishing nail in from the edge, letting it



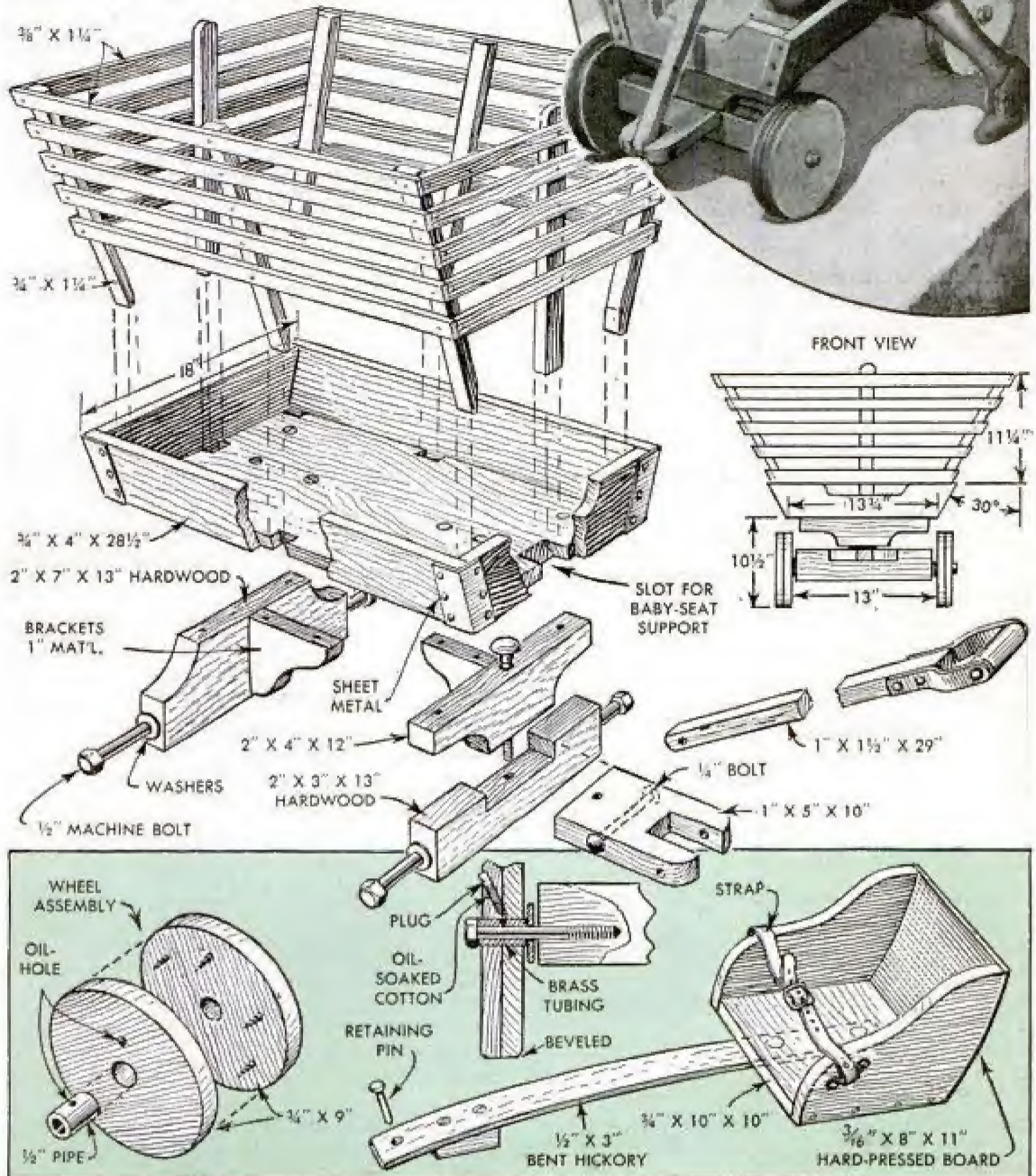
straddle the joint as shown so that it partly embeds in the header and in the jamb, thereby locking the two together securely.

—Wayne C. Leckey, Chicago.

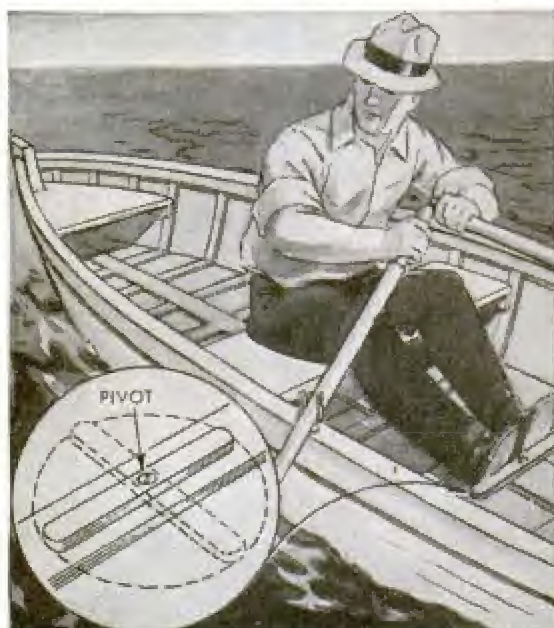


Make This All-Purpose WOOD WAGON

With this wagon the children can take over many of the chores around your home. Built rugged for hard wear and heavy loads, it has a removable spring seat for the baby and a "hayrack" for bulky materials. Metal wheel spindles and bushings make the wagon a free-running coaster



Pivoted Footrest in Boat Swings Out of the Way for Bailing



Footrests usually are attached so that they are in the way when scrubbing or bailing out the boat. If the rest is pivoted, it will serve its purpose equally well and may be turned out of the way when not in use. The pivot bolt or screw should be tight enough to hold the rest in its closed position.

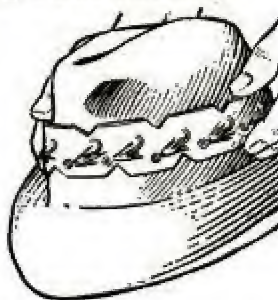
Round-Handle Tools Won't Roll If Sides Are Flattened



Rolling of round-handled tools on sloping surfaces can be avoided by flattening one side of the handle. This is especially helpful with tools that would be damaged by a fall.

Removable Band Slipped on Hat Keeps Fishing Flies Handy

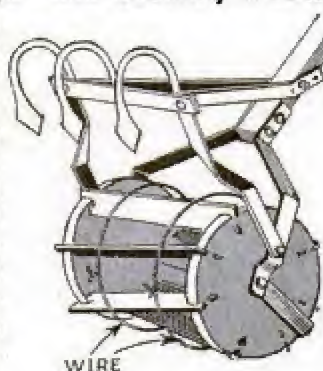
Instead of sticking fishing flies in his hat band and then removing them when through fishing, one sportsman keeps them in a removable band, which he carries in his tackle box



and slips over his hat. Any band of cloth can be used, but a band cut from the crown of an old hat is ideal. If the band is a little too small, it can be stretched by notching the upper and lower edges as indicated.

"Depth Gauge" for Rotary Plow

When your rotary garden plow cuts too deeply in loose porous soils, making it difficult to push and causing it to uproot small plants, twist two or more pieces of medium heavy wire around the blades in the position shown.



These hold the rotor to a more shallow depth. It may be necessary to readjust the scuffle blade to compensate for the shallow cut of the rotor.

Dampened Sand Protects Ax When Burning Out Handle

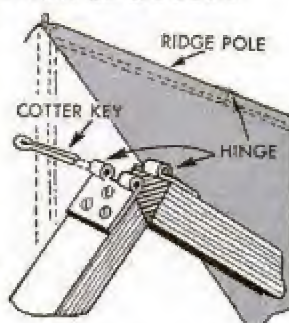


You can burn a broken handle out of an ax with a blowtorch without taking the temper from the blade if it is buried in a pail of dampened sand. By using an old paint pail of a height to hold the ax eye in line with the flame of the blowtorch, you

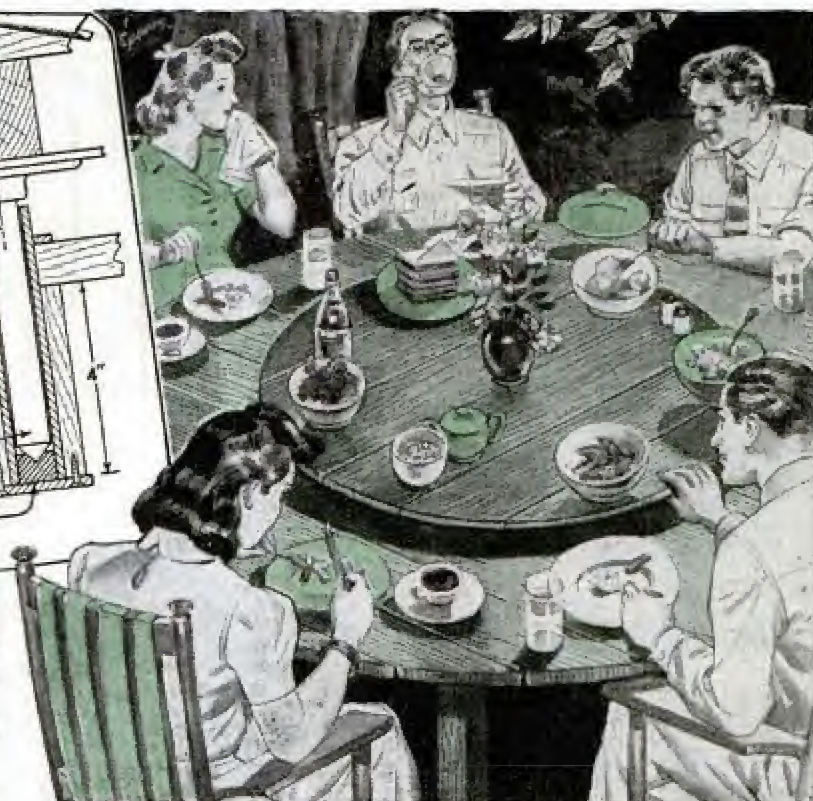
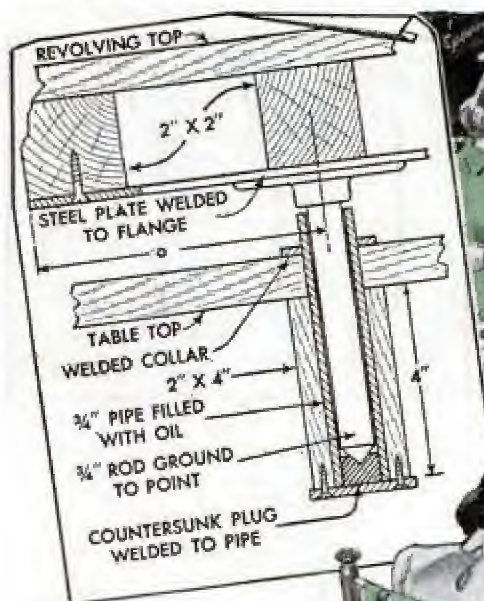
will not be obliged to waste time in holding the torch in place during the burning.

Preventing Loss of Hinge Pin When Tent Pole Is Folded

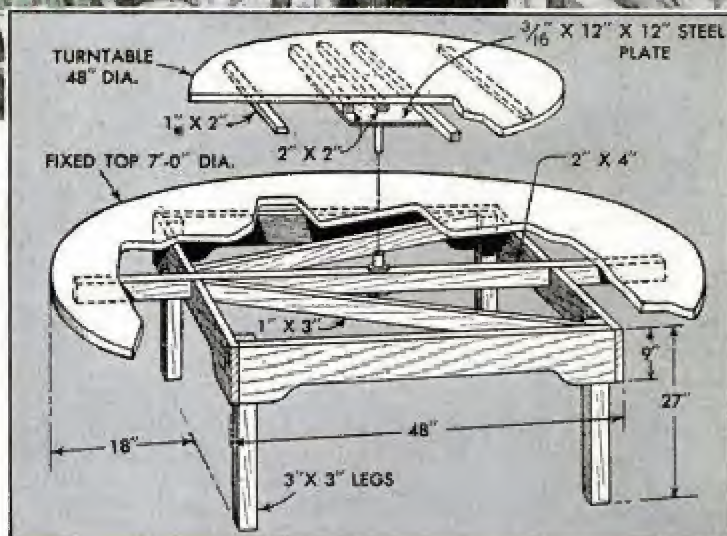
If the ridge-pole of your tent is hinged to fold for convenient packing, and you occasionally lose the loose pin, substitute a cotter key for it. The key should be cut off so that it does not project to damage the tent cloth. Inserted in the hinge, after the pole has been folded, the key will spread sufficiently to hold itself.



Lazy Susan Lawn Table Serves Many Guests



Ten or more guests can serve themselves at this "Lazy Susan" barbecue table by rotating the turntable. If a natural finish is desired, cypress is best, but common lumber, varnished or oiled (linseed oil), will do. Or, you can paint to match other lawn furniture. The axle is an iron bar threaded at one end and screwed into a pipe flange which is welded to a steel plate screwed to the cleats on the underside of the turntable. A second pipe flange screwed to the upper side of the cross bar can be used as a pivot instead of the arrangement shown, but this method will not give such strong support for the turntable, especially if it is unevenly loaded with dishes.



Inexpensive Wallpaper Cleaner You Can Make at Home

For an effective wallpaper cleaner, heat salt, 3 oz. by weight, to a boil in the top half of a double boiler, but do not try to dissolve the salt completely. Transfer this mixture at once to the lower half of the boiler where plain water is boiling and add flour, $\frac{1}{2}$ lb., kerosene, 1 tablespoonful, and stir briskly. Cover and cook for another 15 min., and knead smooth when cool. Dust and dirt can be cleaned off plastered or

wallpapered walls by forming a ball of part of the cleaner. The ball is drawn lightly over the surface, and the dirt should be kneaded into the ball as it collects.

Wiping washing machines and galvanized or porcelain wash tubs with a rag dampened in kerosene eliminates soap scum and gives the tubs a high polish. The kerosene odor soon disappears.

How to Make



By Walter E. Burton

DURABLE concrete is a result of careful selection of materials, correct proportioning of ingredients, especially the cement and water, and proper treatment after pouring the concrete. For best results, there are a few tests that anyone can employ to judge materials, and equally simple rules to follow in mixing the ingredients. First is the correct selection of aggregate, which is sand and gravel. Fine sand is composed of particles ranging in size from just a bit larger than dust, to pebbles that will pass through a screen having four meshes to a linear inch. Coarse aggregate or gravel consists of particles ranging in size from $\frac{1}{4}$ in. to $1\frac{1}{2}$ in. or more. The largest size of gravel to use is dependent, in many cases, on thickness of the concrete work. Generally, no particle larger than

one third the thickness of the thinnest section of the work should be used.

For concrete that will stand long wear, use aggregates made of hard, sound material. Soft or flaky aggregates will not stand much weathering, and sometimes are responsible for unsightly holes often seen in improperly puddled sidewalks. The aggregate should be well graded. That is, it should consist of particles of various sizes so proportioned that they will fit nicely together to form a uniform mass, with the smaller particles filling the spaces between the larger ones as in Fig. 9. In most cases, material direct from a sand or gravel bank is not proportioned correctly as to particle size, and usually contains too much sand. It must be washed, screened and recombined for best results. For this reason it is best to purchase your aggregate from a dealer who sells aggregate washed and correctly graded. Good concrete cannot be made with sand that contains an appreciable amount of extremely fine material (silt). Sand can be tested very easily for

CONCRETE *That Will Last*



silt content with nothing more than a quart fruit jar and a ruler, Fig. 1. Fill the jar to a depth of 2 in. and pour in enough water to fill the jar about three-quarters full. Screw on the lid and shake the jar vigorously for a minute. Then set it aside for an hour, or until the water clears. The silt, settling out of the water, will form a layer on top of the sand. If this layer is more than $\frac{1}{8}$ in. thick, Fig. 2, the aggregate is unfit for use, and should be washed to remove the fine material.

Another thing that causes poor concrete is too much organic matter in the sand; bits of roots, pulverized leaf mold and so on. A simple test for this is shown in Fig. 3. Get a 12-oz. prescription bottle from the drug store, and fill it with sand to the $4\frac{1}{2}$ -oz. mark. Dissolve sodium hydroxide (caustic soda), $\frac{1}{4}$ oz., in water, 8 oz. and pour this into the bottle to the level of the 7-oz. mark. Cork the bottle and shake it for several seconds. Then let it stand for 24 hours. By examining the color of the liquid, you can judge the amount of organic matter present as indicated by bottles A, B and C in Fig. 3. If it is clear, the aggregate contains no organic material. A straw color is caused by the presence of some organic matter, but not enough to

cause trouble. If the solution is dark, there is too much vegetable material and the sand should not be used for concrete. This test is useful for appraising new sand deposits as well as for checking sand you buy from a dealer or that which has been stored in the open for a long time. The test is easy to make, but caution should be exercised in handling the hydroxide solution, which is injurious to the skin, leather and clothing.

Any water that is suitable for drinking can be used for making concrete. Do not use water containing salt, as it will make reinforcing bars rust. The amount of water used in proportion to the cement is highly important. Hardening of cement is a chemical action in which the cement combines with a certain amount of water to form a permanent compound. If too much water is used, there will be small spaces or voids in the concrete after the excess water evaporates, and the concrete will not be watertight and durable. Extensive research on the amount of water to use for best results has been carried out until today the rules are fairly well fixed and easy to follow as indicated by the table in Fig. 11. When mixing concrete with special attention to the quantity of water, the amount of moisture already in the sand must be



taken into account. Water in the coarse aggregate does not matter because the maximum volume such aggregate can retain is low. Sand can be divided into four classes: very wet, wet, damp and dry. You can test these conditions accurately enough with your hand. Very wet sand is dripping wet, and leaves much moisture on the skin when handled. Wet sand, which is the condition usually encountered, feels wet to the touch, and leaves a small amount of moisture on the skin. Damp sand feels a little damp but leaves almost no moisture. Dry sand runs freely through the fingers. In general, the amount of water in a cubic foot of sand can be expressed as follows: Very wet sand, $\frac{3}{4}$ gal. or 6 percent, wet sand, $\frac{1}{2}$ gal. or 4 percent, damp sand, $\frac{1}{4}$ gal. or 2 percent, and dry sand, none. If you want to be exact on the amount of

water in the sand, spread some of it, say 2 lbs., in a shallow pan. Then mix denatured or wood alcohol thoroughly with the sand and ignite it. Continue stirring as the alcohol burns. If the sand still seems damp after the alcohol has burned, repeat the treatment. Let cool for about 10 min. Then weigh the sand again. The percentage of moisture can now be calculated by subtracting the dry weight from the wet weight and multiplying by 100.

If you have a quantity of concrete to mix, first make a trial batch. Try the proportions suggested in the table. If the batch is too stiff, reduce the amount of aggregate or add more water and cement. Do not add water alone, for that upsets the cement-water ratio. If the batch is too thin,



simply add more aggregate, but not more cement. In general, a stiff concrete is best for footings, foundations, pavements and walls, while a more plastic mixture is best for work that is of thin section. You can use the slump test, Figs. 4 and 6, to determine the consistency of concrete. First make a sheet-metal cone of 16-ga. galvanized iron. Set the cone, large end down, on a flat surface, and fill the cone about one-fourth full. Compact this by puddling with a $\frac{5}{8}$ -in. iron rod, using 25 strokes. Add concrete to fill the cone to about half its depth, again puddle with 25 strokes and finally fill the cone completely, and puddle as before. Now lift the cone straight up, leaving the concrete on the board or slab or whatever surface you used. The "slump" of the pile is the difference in inches between its height, measured as soon as the cone is removed, and the height of the cone. If the slump is from 1 to 4 in., the concrete is of the right consistency for massive construction such as pavements and floors laid on the ground. A slump of 3 to 6 in., indicates concrete suitable for posts, walls, beams, heavy slabs and tank walls. Concrete that slumps from 4 to 8 in. is best for garden furniture and vases, ordinary beams or slabs, columns and thin

walls. The three slump batches pictured in Fig. 5 show stiff, medium and wet concrete mixtures.

For sidewalks, driveways and terraces, Figs. 7 and 12, the concrete can be placed directly on the ground if there is good drainage, first tamping the earth to compact it. If drainage is poor, use a 6-in. layer of clean, coarse gravel or clean cinders beneath the concrete. Compact this sub-base thoroughly. Concrete should be placed in the forms within 30 min. after mixing, Fig. 10. Puddle it thoroughly with a stick, spade or trowel, to work the coarser particles of aggregate away from the forms and the top surface and thus produce a uniform outer surface on the work.

And finally, after you have gone to the trouble of making and placing your con-

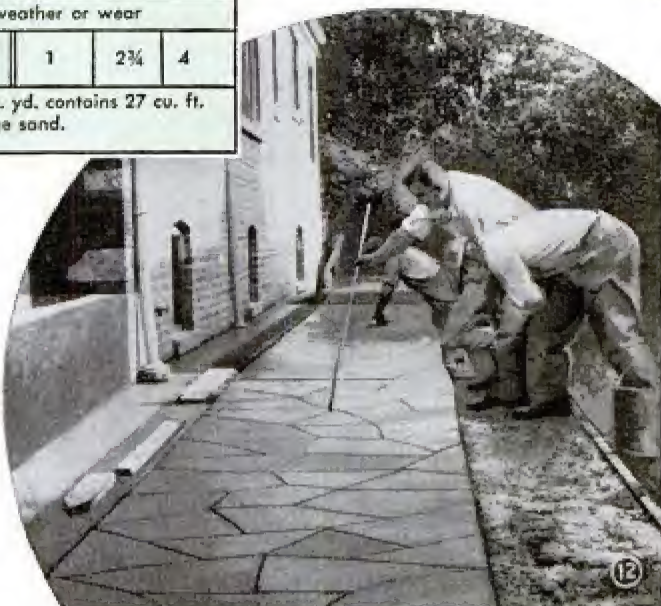


11 WATER AND CEMENT PROPORTIONS <small>Courtesy Portland Cement Association</small>						
Kind of Work	Water, gals. per sack of cement			Suggested trial-batch mixtures		
	Very wet sand	Wet sand	Damp sand	Cement, sacks	Aggregates Fine cu. ft.	Coarse cu. ft.
5-gal. paste, for greatest durability						
Topping for heavy wearing surfaces and other 2-course work such as pavements, tennis courts, walks, floors	4¾	4½	4¾	1	1	1½
One-course industrial, dairy and other floors, and concrete subjected to weak acids and alkalis	3¾	4	4½	1	1¾	2
6-gal. paste, for watertight concrete exposed to moderate weather						
Watertight floors, foundations, walks, drives, tennis courts, storage tanks, septic tanks, swimming pools, reinforced structural beams, slabs, etc.	4¾	5	5½	1	2¾	3
7-gal. paste for concrete not subjected to water, weather or wear						
Foundation walls, footings, mass concrete	4¾	5½	6¼	1	2¾	4
Note: In calculating mixes, remember that 1 cu. yd. contains 27 cu. ft. Sand classed as "wet" in table is average sand.						

crete correctly, don't lose half of its strength by improper curing. Concrete that is kept moist seven days is 50 percent stronger than concrete that is permitted to dry out immediately. Keeping it damp one month boosts the strength 100 percent. To keep sidewalks, driveways, floors and the like moist, cover them with straw, leaves or earth as soon as the surface has hardened enough to prevent marring, and sprinkle occasionally with water. Cover vertical walls with burlap, canvas or old carpet, and keep moist for ten

days. In cold weather protect the work but do not moisten it. Extra attention to quality of materials, methods of mixing, etc., will assure long life for projects such as the concrete outdoor living room in Fig. 8.

Remember to tamp the earth or base under a sidewalk or driveway thoroughly; use aggregate that has been graded properly, proportion the cement, water and aggregate correctly and mix the ingredients thoroughly. Puddle the cement to bring the fine particles to the top and make a smooth, finished surface.



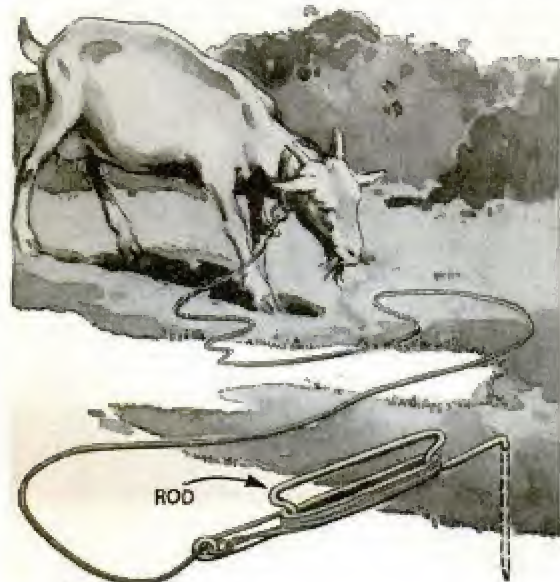
Pusher Handle on Coaster Wagon Keeps It Under Control



To allow his child the thrill of steering his own coaster and still keep it under control to avoid possible accidents, one father made a control handle like the one shown. This consists of a handle from a discarded carpet sweeper, the braces of which may be sprung to engage holes punched in the sides of the coaster body near the back. The handle is easy to attach or remove.

Bent Rod Makes Stake and Reel For Pony or Goat Tether

When it is desired to tether an animal where the rope must be shortened occasionally to restrict the feeding range, make the tether stake from a rod as shown. The

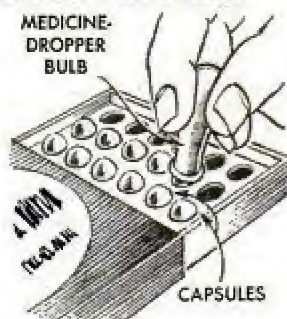


free end of the rope should be tied to the loop at the end of the rod and the remaining rope may be wrapped around the reel section to shorten it as desired.

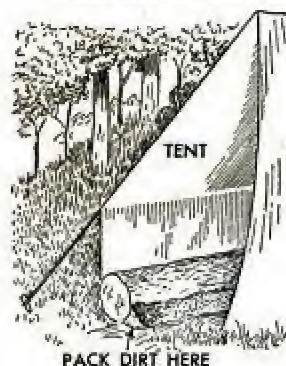
Capsules Removed From Box Easily With a Rubber Bulb

If you have experienced difficulty in removing vitamin capsules from their containers, try using an old medicine-dropper bulb to lift them. The bulb will slip snugly over most capsules of this type.

It may help to squeeze the bulb while placing it over a capsule and thus create a partial vacuum inside the bulb, when it is released, to aid in gripping the capsule.



Tent Walls Pegged to Small Logs Exclude Insects and Water



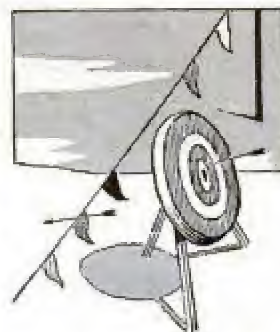
Campers who pitch a tent for several days at a time will find this method of fastening down the side walls of the tent ideal for keeping out insects and water. Just place small logs inside the tent next to the walls and fasten them to the

logs. Pack dirt along the inner sides of the logs as indicated.

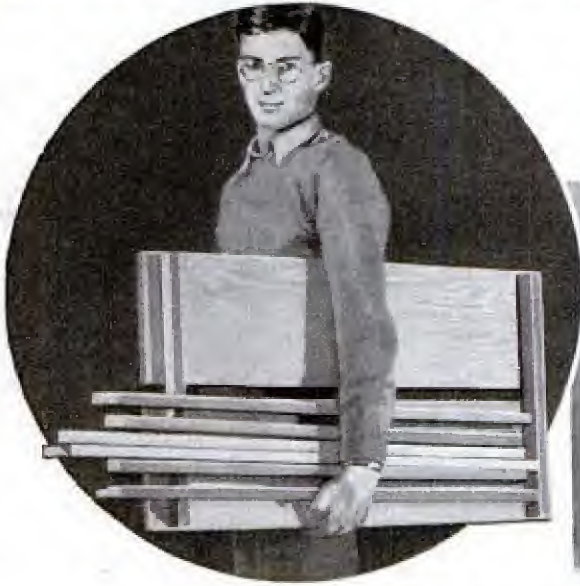
—Corp. Darrell Roberts, Arcadia, Calif.

Colored Pennants Help Locate Lost Archery Arrows

As an aid in noting the path of archery arrows that miss the target, one instructor attaches pennants of different colored cloth to a string, which is then stretched between stakes placed to one side and slightly behind the target. By noting the color of the pennant in the path of the arrow, a player can follow the line of flight easily.

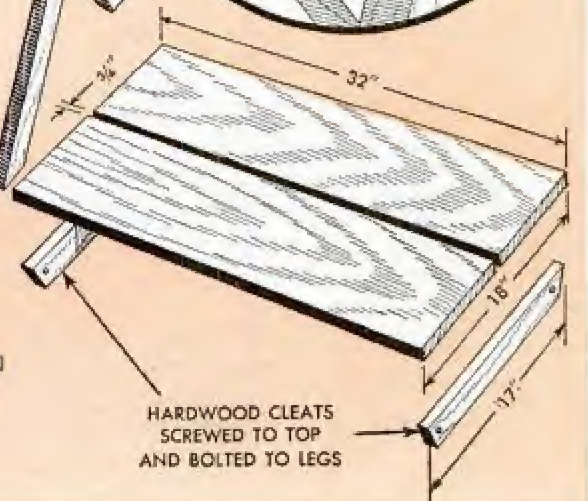
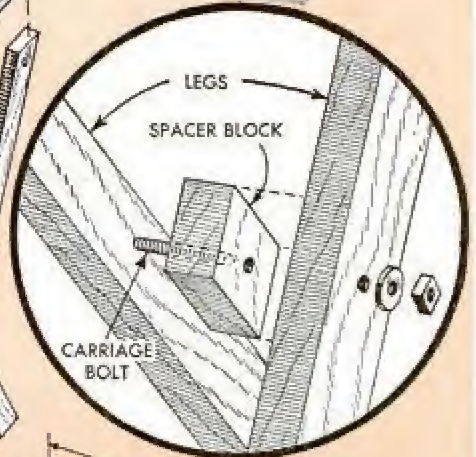
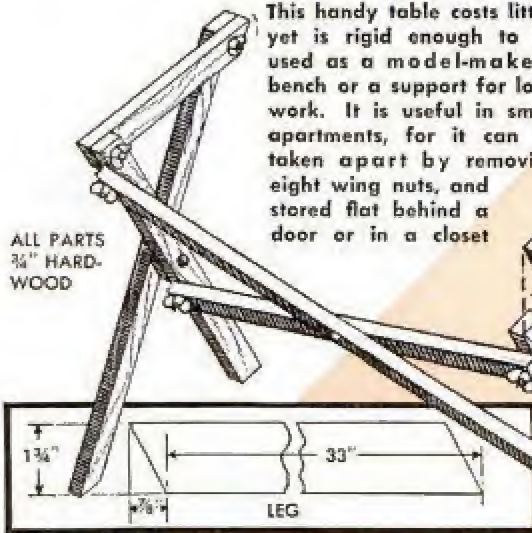


Knockdown WORK TABLE



This handy table costs little, yet is rigid enough to be used as a model-maker's bench or a support for long work. It is useful in small apartments, for it can be taken apart by removing eight wing nuts, and stored flat behind a door or in a closet

ALL PARTS
3/4" HARD-
WOOD



Folding Porch Chair Converted Into Walker for a Baby

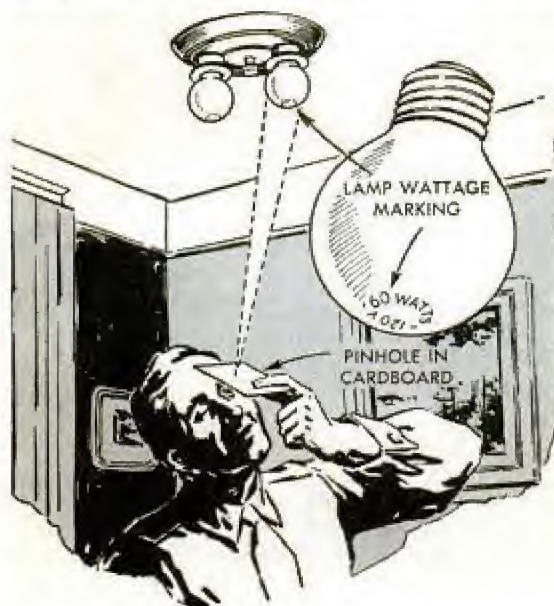


Being unable to locate a walker for our baby, I built one from the frame of a folding porch chair. The back and seat were removed from the chair and casters were put on the legs, after which a canvas strip 4 in. wide was tacked between the front and rear cross members to form a saddle. The walker still folds just like the chair, permitting it to be stored in a small space.

—Fred A. Beard, Detroit, Mich.

Wattage of Overhead Lamp Read Through Pinhole in Cardboard

Instead of climbing a ladder to read the wattage marked on the end of a lighted lamp bulb that is mounted in a vertical



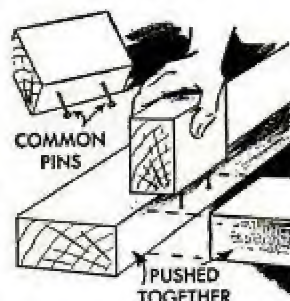
position overhead, look through a pinhole in a piece of cardboard and you can read the lettering provided the lamp is not too high from the floor. Hold the cardboard in front of your face, close one eye and look through the pinhole with the other eye.

—Thomas Trail, Baltimore, Md.

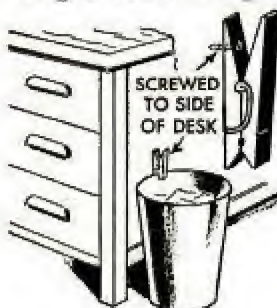
Simple Marking Jig Aligns Mating Dowel Holes

With two pins in a block, the job of locating mating dowel holes accurately is simply a matter of placing the block on one member as shown and pressing the joining member squarely against the pin heads to make impressions (drilling points) in both pieces. The pins, of course, must be spaced and extend the proper distance to suit the work.

—Wayne C. Leckey, Chicago.



Clip Holds Paper Basket Upright



To avoid tipping waste baskets in one office, the side of each desk is equipped with a spring-type clothespin. This is screwed to the desk at the same height as the paper basket. The edge of the latter

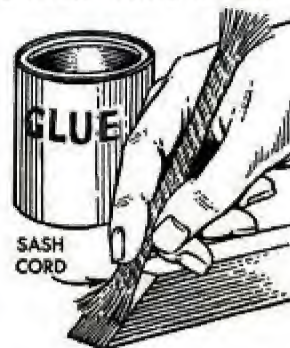
is slipped between the jaws of the pin and is held securely, although it is easily released for emptying.

—Ken Murray, Baltimore, Md.

Glue Brushes From Sash Cord

Instead of discarding an old piece of sash cord, cut it into 6 or 8-in. lengths, and fray the ends so they can be used as glue brushes. These are especially useful because they can be disposed of when a job is finished, thus eliminating time required to clean an ordinary brush.

—Pvt. Don Brooks, Fort Ord, Calif.



Refinish That Old Floor

By
J. C. Montgomery

WITH a modern floor-sanding machine, anyone can refinish an old floor, even one in which the surface is badly scarred and the boards are buckled slightly at the joints. In most towns and cities these sanding machines are available for rent in hardware stores, lumber yards and paint stores. The floor should be sanded deeply enough to cut down the buckled joints, and to remove all the old stain and finish. Usually this is done by going over the floor first with a sanding belt of very coarse grit, then one of medium grit, and finally with one of fine grit.

After sanding, careful treatment is necessary to bring out the full beauty of the wood. Protect a newly sanded floor with paper as in Fig. 1 until it is refinished. Floors of oak or other open-grained woods should be filled. Otherwise, dirt accumulating in the pores will cause permanent



1 PROTECT FLOORS FROM FOOTPRINTS

2 Filler for 12 by 14-ft. floor	
Silica (silverwhite) -	2 lbs.
Boiled linseed oil -	20 oz.
Benzine -	40 oz.
Raw sienna -	½ oz.



3 KEEP THE FILLER STIRRED



4 APPLY FILLER FIRST WITH, THEN ACROSS GRAIN

Mix just enough filler for one room at a time and work on small areas until you have gained experience in wiping the filler. As silica in the filler is heavy and sinks, stir filler thoroughly before each application



blemishes. Sufficient filler for a room 12 by 14 ft. can be prepared inexpensively as indicated in Fig. 2. Mix the filler in a large receptacle that can be discarded afterwards, and mix only enough for one room at a time. The filler will stain the floor slightly. You can vary the amount of sienna to get darker or lighter effects. If still darker tones are desired, substitute burnt sienna or burnt umber for the raw sienna. Use pure benzine, not the kerosene-and-gasoline mixture sometimes sold.

Apply the filler liberally with a brush or a wad of cotton waste, first with and then across the grain as in Fig. 4. Since the heavy silica sinks rapidly, the filler must be stirred each time the applicator is dipped into it, Fig. 3. Work on small areas of the floor until experience in wiping has been gained. Wiping is done across the grain, Fig. 5, and is best done when the filler is partially set, which usually takes from 15 min. to $\frac{1}{2}$ hr. If wiped too soon, the filler is removed from the pores, and if done too late, the hardening filler is difficult to remove. When the surface carries a deposit that looks and feels like moist clay, the filler is ready for wiping. Excelsior or wood wool is excellent for this purpose. Also, pieces of burlap sacking about 8 by 20 in. can be folded into useful four-ply pads, and refolded frequently to expose clean cloth. After the excess filler appears to have been removed, place your face close to the floor and look toward a light. A portable lamp is handy for this purpose.

A dark, cloudy smudge indicates that all the filler has not been removed. Further rubbing with a fresh piece of burlap will produce a shiny, finished surface, Fig. 6.

Protect your knees with burlap or other cloth padding while wiping the floor, or wear old clothes which can be discarded. All cloths and burlap containing filler should be disposed of immediately as they contain enough oil to cause spontaneous combustion. Let the filler dry at least 24 hrs. Smooth with No. 0 sandpaper, and dust. Finish with one or two coats of good, hard floor varnish. More than two coats of varnish is not recommended. Maple floors may be filled with one coat of shellac, then finished with two coats of varnish. When dry, each application of varnish should be rubbed lightly with No. 00 sandpaper and dusted before applying the next coat. Lastly, apply floor wax and rub to a high polish.

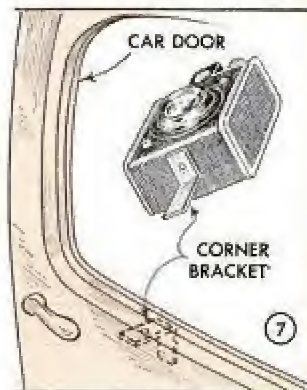
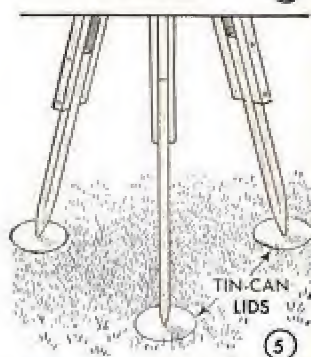
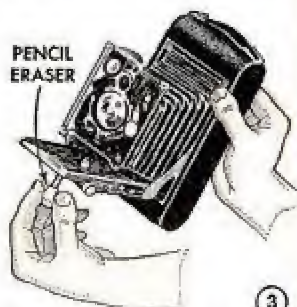
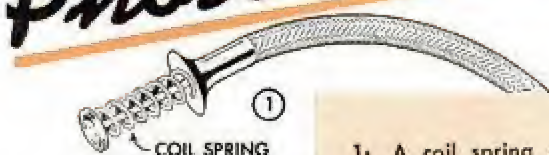
Liquid Shoe-Polish Bottle Handy To Carry Shellac in Pocket

An easy way to carry a small amount of shellac for covering taped wire splices and similar jobs is to place it in an empty liquid shoe-polish bottle. The polish applicator, when cleaned, is handy for brushing on the shellac, and the bottle can be carried in your pocket or toolbox.



—James L. Justmann, Portland, Ore.

Photo Kinks



1: A coil spring under the button of the cable-release plunger prevents damaging the shutter by too sudden snapping

2: Develop 35-mm. film in a tray on paraffin-treated cardboard with notches to hold the film

3: Your camera will not slip on smooth surfaces if a pencil eraser is put on the front support

4: Cellulose cement will protect a tray thermometer against breakage

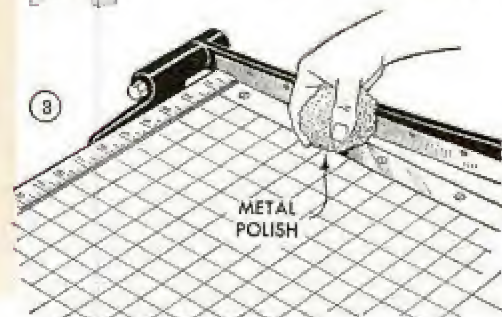
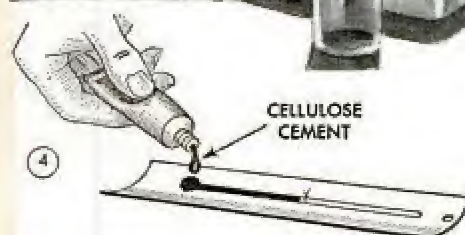
5: Lids of tin cans used to support tripod legs on loose dirt or sand

6: Place prints between blotters and run slowly through family mangle to dry them quickly

7: To use a car door as a tripod, bolt a corner bracket to your camera and slip in window slot

8: Polishing the shearing plate of your trimming board with a metal polish will permit more accurate cutting in dark-room by reflected light

9: Very fine pumice to which one drop of light oil is added makes an effective, cheap abrasive paste for local reduction of negatives



Deckle Edges on Photo Prints Made With Pinking Scissors



Edges which will make your prints stand out when mounted in the album are cut with pinking scissors, normally used in sewing. For large prints a faint penciled guide line will help to keep the scissors going straight.—John Karlovic, Chicago.

Supporting Camera for Low Shots

Taking advantage of the fact that a wire eggbeater of the type shown is so easily fastened between a camera tilt-head and the tripod, one photographer used such a beater to steady his camera when taking low-angle shots of plants and flowers. The extra leg thus provided can be adjusted from 4 to 8 in. in height. Of course, the same effect can be obtained by attaching a

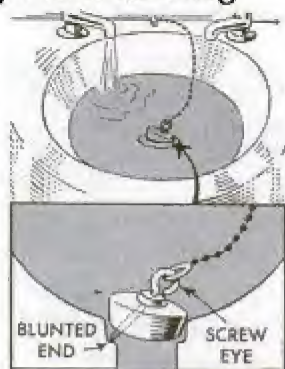


length of doubled wire of sufficient thickness to give rigidity.

—John A. Moore, Havre, Mont.

Flow of Water for Washing Prints Regulated by Altered Plug

When home photographers use a bathroom wash bowl to wash prints under running water, usually the excess water is drained away through the overflow. However, as hypo is heavier than water and settles on the bottom, it is



much better to drain it at the bottom simply by adjusting the stopper as shown. To convert a stopper for this purpose, you remove the metal ring from it and insert a large screw eye at the angle shown and file the projecting point smooth. The stopper can be placed so that it either will let a small amount of water through or close the drain entirely in the ordinary manner.

Coffee Gives Prints Sepia Tone



If you like sepia-toned prints, you can make them inexpensively by dipping them in a solution of coffee. The strength of the coffee will determine the tint, and the proper shade can be found by experiment. After the prints are tinted, wash them in running water for a few minutes and dry in the usual manner.

—William Swallow, Brooklyn, N. Y.

❑ A quick-drying, dull-finish photographic paint is made easily by dissolving a broken phonograph record in alcohol. This also makes an excellent blackboard paint.



SHOP NOTES

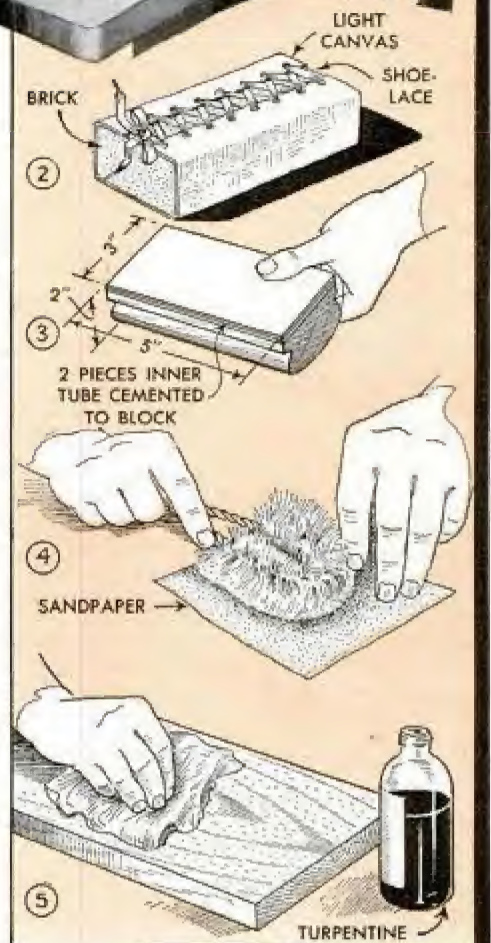


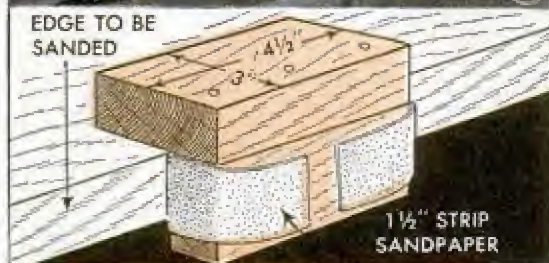
SMOOTH SANDING

By R. F. Yates

AMATEUR mechanics often fail to obtain the full value from their coated abrasives because they do their sandpapering by rule-of-thumb methods. It is possible, however, to get more value from each piece of abrasive and turn out smoother work. Abrasive papers are coated with particles of garnet, quartz, flint or aluminum oxide. These abrasives come in standard 9 by 11-in. sheets and in belts, disks, cones, drums and strips for special purposes. Grits are numbered from 8/0 to 4, the finer grains—those from 8/0 to 2/0—having softer, more flexible paper backing. Medium grit papers used in preliminary treatment of cabinet woods range from 1/0 to 2, and very coarse papers for removing paint or for fast cutting range from $2\frac{1}{2}$ to 4. There is a choice of grit for every purpose and for every type of wood; the closer the grain and the harder the wood, the finer the abrasive must be for the finishing operation.

Grit papers lose their cutting power when the abrasive particles become dull and when wood dust packs between them. By turning the sanding block at a 90-degree angle or by reversing it as soon as the paper becomes dull, a new cutting edge will be brought into use, thus adding





as much as 50 percent to the life of the paper. Packing of wood dust between the abrasive particles cannot be prevented but can be minimized by occasionally brushing the abrasive with a stiff brush, as in Fig. 4. Wood dust also plugs the pores of the wood and, unless it is removed, it might spoil the finish coat. To prevent this, the wood should be brushed thoroughly, then wiped off with a clean cloth moistened with turpentine, as in Fig. 5.

Where irregular surfaces are to be sanded, the little gadget illustrated in Fig. 1 will be useful. The tool is placed in the chuck of a drill press with the cutting side of the abrasive facing the direction of rotation. Fine emery cloth will last longer in this operation than paper-backed abrasives. In straight sanding, the line of movement should be with the grain. Equal pressure should be applied on all points, and the abrasive must not be twisted or it will cause cross-grain scratches that cannot be removed easily. By using blocks around which the paper is wrapped, greater pressure can be applied than with the fingers alone, and there will be less chance of grooving the wood, especially with coarse, fast-cutting papers. Such a block can be made from an ordinary brick or piece of wood covered with light canvas, as in Fig. 2. A softer block and finer paper should be used for re-working the first heavy sanding. A blackboard eraser or slab of cork makes an ideal block, or one can be made from a piece of wood to which pieces of inner tube or sponge rubber are glued, as in Fig. 3.

The sanding block shown in Fig. 6 will help to keep the edges of cabinets and tabletops square without the rounding often noticed in the work of inexperienced workmen. After a perfectly square surface is produced, a few light strokes with fine paper will take off the sharp knife edge. Wrapping the paper around a wood dowel, as in Figs. 7 and 8, will enable the craftsman to reach all curved surfaces, especially if the paper is first soaked in turpentine to make it more flexible. Where small pieces are to be sanded by hand and kept square, the sanding board shown in Fig. 9 will help a great deal. Often two edges may be sanded simultaneously with this arrangement.

Improperly treated end grain may ruin an otherwise beautifully finished piece of furniture. Therefore these ends must be sanded to an almost glazed surface, otherwise they will absorb more than their share of the stain or varnish. Some woods require sponging and re-sanding with fine paper to bring out the proper accentuation of grain effects. In such cases, water is applied to the wood with a soft cloth after the first sanding with fine-grit paper. The



wood should be thoroughly dried before re-sanding, and only very light pressure used with papers of 2/0, 3/0 or 4/0 grits.

The amateur finisher should not overlook the usefulness of steel wool. This comes in grits of 2, 1, 0, and 000. The 000 wool leaves a hardwood surface with a satin sheen that cannot be achieved with grit papers. Of course the same rules apply in using wool as in sanding to avoid cross-grain scratching.

Varnish sanding between coats was formerly pretty much a fine art. However, with wet sandpapers it is possible to achieve pleasing effects without a great deal of experience. Wet-sanding papers come in extremely fine grits from 8/0 to 6/00, are extremely tough, and are impervious to water. To make them more flexible, such papers are soaked in water before they are applied, as in Fig. 10. The varnished surfaces to be sanded are also kept moistened by water applied with a sprinkler bottle, as in Fig. 11. The water modifies the cutting action of the paper



and prevents the scratches that would result if the paper were used dry.

After using this paper, the varnished surface should be carefully sponged off and wiped as dry as possible with a chamois to avoid leaving lint on the surface. These papers work so well that they often may be used instead of the felt pad and pumice usually employed for the finish coat. However, since they cut much faster than pumice, the workman must be careful not to carry the operation beyond the point needed for the type of finish he seeks, otherwise he might find that he has cut through the varnish.

Emergency Three-Rail Ladder Handles Two-Way Traffic



Constructed of 2 by 4-in. stock right on the job, this ladder was found to be stronger than the regular two-rail type, and had the advantage in restricted places of permitting two workmen going in opposite directions to use it at the same time. Both the steps and rails are spaced closer together than on the conventional ladder, making it easier to carry heavy loads.

Corrugated Fastener Scrapes Wire

A corrugated fastener provides a sharp and convenient scraper and cleaner when preparing insulated wires for soldering. The irregular-shaped cutting edge is easy to hold on the wire.



Disks Trued-Up Quickly in Lathe With Rotary "Turning Tool"



Having a number of metal disks to be trued-up, and after finding that it required too much time to do the job in a lathe in the usual way, I used a rotary tool as shown. This was held in the tool post and when brought up against the rotating work in the chuck, pressed the disk up true. The tool consisted of a 2-in. roller mounted on a piece of 1 by $\frac{3}{4}$ -in. steel as shown in the detail.—H. D. Chapman, Mt. Rainier, Md.

Heavy Oil Drums Moved Easily On Detachable Casters

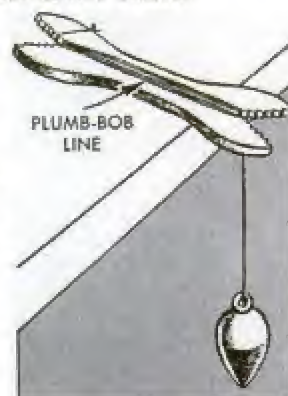
One filling-station operator solved the problem of moving heavy oil drums about his station by using four detachable caster units. Each unit consisted of a caster riveted to a piece of flat iron, which was bent



to the shape shown in the detail. These units slip under the drum where they are held in place by the rim around the bottom of the drum. Heavy trunk-type casters should be used for this purpose.

Wrench Makes Reel and Holder For Plumb-Bob Line

A discarded alligator wrench provides a convenient reel and holder for a plumb-bob line. The end of the line is looped and knotted to fasten snugly over one of the wrench jaws, and then is wrapped lengthwise around it to adjust the suspension of the bob. The weight of the wrench permits the bob to be suspended from any flat surface without nailing.



Tin-Can Weights Avoid Errors In Weighing Coal Trucks

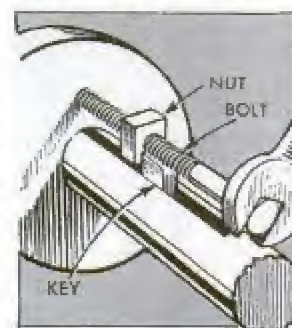


In weighing trucks or other vehicles on a single-beam scale where an error may be made in figuring the tare to be deducted, one coal yard operator uses extra weights made to balance each truck. These weights consist of screw-top cans

filled with sand and each carries the number of the truck it represents. The balance weight of the scale beam and the cans are provided with hooks.

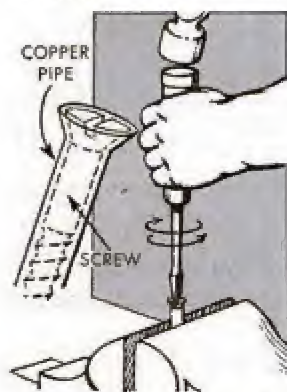
Bolt and Nut Pull Gib Keys

Instead of trying to knock out a gib key with a hammer and punch when suitable pullers aren't at hand, try using a bolt and nut. Just place the nut behind the key, as shown, then turn the bolt with a



wrench. The end of the bolt resting against the pulley, wheel or other part held in place by the key will cause the nut to move along the bolt and pull the key. If space between the key and the wheel or pulley is too small to permit insertion of the nut, usually the key can be started by driving a chisel horizontally between them.

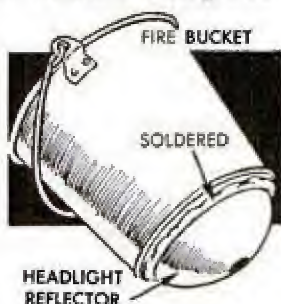
Copper Tube Flanged With Screw



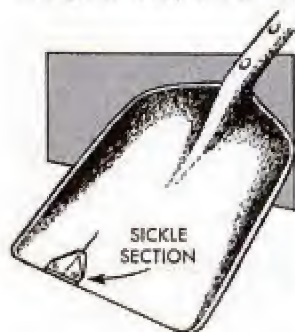
The next time you have to form a flange on the end of a piece of copper pipe or tubing and there are no suitable tools at hand, use a wood screw. Simply grip the tube carefully in a vise, insert the screw and turn it back and forth with a screwdriver, tapping the upper end of the driver lightly with a hammer as you turn the screw.

Reflector Soldered on a Fire Pail Prevents Use for Other Purpose

Annoyed at the careless practice of some workmen using fire pails in the shop for other purposes, one garage owner soldered discarded headlight reflectors to the bottoms of the pails. These false, rounded bottoms made the buckets so they would not stand up but had to be left on the hooks that were provided for them.

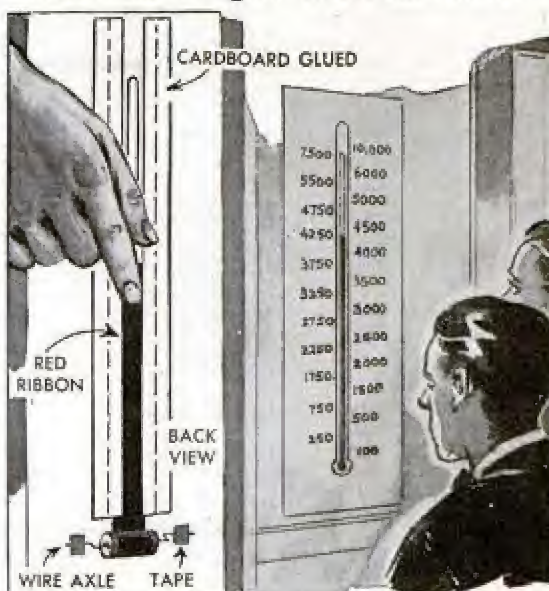


Repairing Cracked Grain Scoop



A quick and practical repair for a cracked scoop that might otherwise have to be discarded may be made by punching holes through the metal at each side of the crack so that a discarded mower section can be riveted over it. Place the sickle section on the upper side of the scoop so it will not damage a floor when the scoop is in use.

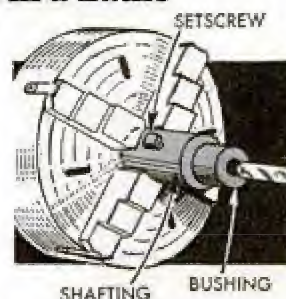
Progress of Sales Contest Shown On This Simple 'Thermometer'



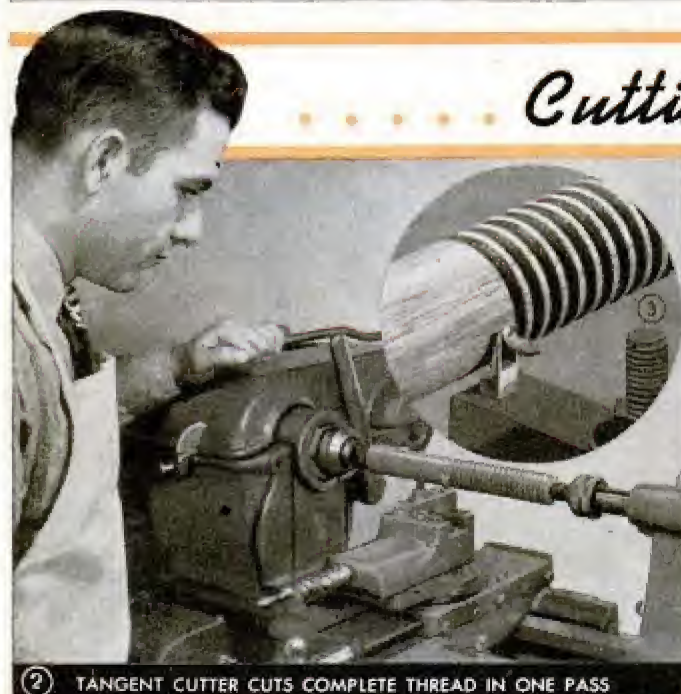
Results of a sales drive or other contest are shown at a glance on this thermometer. It consists of a large piece of heavy cardboard fitted with a red paper ribbon, which slides in a track behind a slot in the center. The track is formed by gluing strips of cardboard on each side of the slot, and the paper ribbon is wound on a spool, which rotates on an axle shaped from wire and held in place with cellulose tape. Height of the ribbon in the track is adjusted by moving it up or down with the finger as indicated in the left-hand detail.

Fixture to Make Small Bushings Quickly in a Lathe

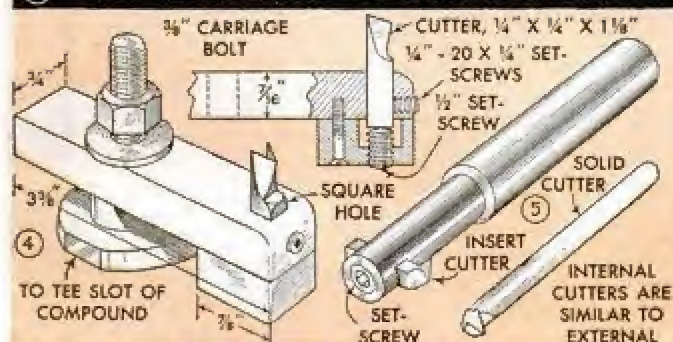
Having an order for several hundred small bushings to be made in our shop, we cut the cost in time and labor to a minimum by using a fixture like the one shown. Once the fixture was chucked accurately in the lathe, it served as an auxiliary chuck for holding the bushing stock in true position for drilling, and from which the finished bushings could be inserted and removed by merely tightening and loosening a small setscrew. The fixture was made from a piece of shafting $\frac{1}{2}$ in. shorter than the length of the bushings, and was bored out to the same diameter as the finished outside diameter of the bushings.



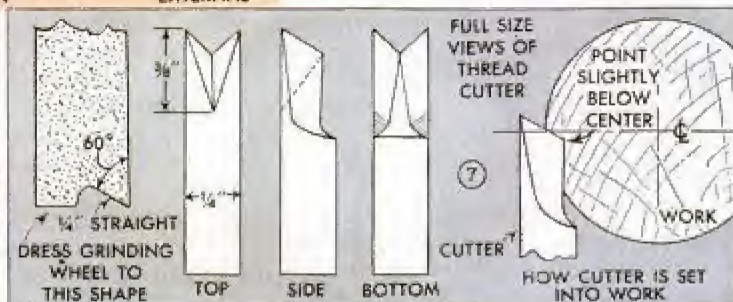
—J. E. King, Waxhaw, N. C.



② TANGENT CUTTER CUTS COMPLETE THREAD IN ONE PASS



⑥



Cutting THREADS

By Sam Brown

THREADS in wood have a wide application, and the job of cutting them is quite simple. A lathe with a lead screw is almost a necessity, but work can be done with hand-screw boxes and by hand chasing.

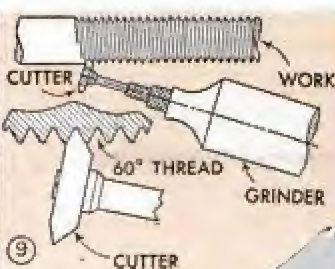
Woods to use: Proper selection of wood is important. Excellent woods for this purpose are white birch, hard maple, beech, persimmon, apple, cherry, ironwood, hickory and dogwood. Walnut and mahogany rate second choice because their coarse-grain structure tears slightly. However both are workable. Among imported hardwoods there are many, such as lemonwood, ebony, cocobola, lignum vitae, etc., all so tough they can be turned with an ordinary threading tool. For most work the logical choice is white (paper) birch or hard maple, both common domestic hardwoods. A distinction should be made be-



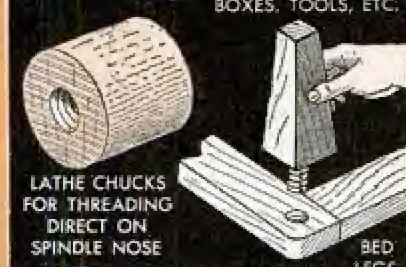
3/8" DIA. (FOR 3/8" HOLE SHAPER CUTTER-
1/8" WIDE)



NO. 10 - 24 X 1/2" F. H. MACH. SCREW



SHAPER
CUTTER METHOD
PRODUCES CLEAN
WORK AND CAN
BE USED FOR
EXTERNAL OR
INTERNAL
THREADS



in WOOD

tween hard and soft maple—it's all "maple" to many lumber yards, but all the difference between success and failure when it comes to holding a thread.

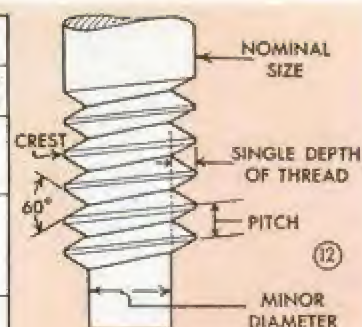
Thread styles: The conventional 60-degree thread as practiced in metal work is equally good on wood, the one difference being that in any given size the thread pitch for wood is much coarser than for metal. Fig. 1 shows typical examples, the diameters averaging about 1 in. A is birch, 8-pitch. B is maple, 8-pitch, but a double thread as differing from A. C is cherry, 4-pitch, and D is lemonwood, 4-pitch. E is walnut, 4-pitch, with flats somewhat wider than normal in order to eliminate grain chipping as much as possible. F is a 4-pitch spiral thread, excellent for decorative use and subject to very little chipping. G is birch, 4-pitch, cut with a screw box.

Tangent cutter: The tangent cutter shown in Figs. 2 and 3 is the best for cutting V-threads. It cuts a clean thread as coarse as 4-pitch in one pass. The cutter is V-shaped and can be compared to twin thin, sharp chisels standing on end. It is held in a special holder, Fig. 4, and is presented to the work in a tangent position, Fig. 7. The same style cutter for internal threads is of similar shape as can be seen by comparing Figs. 4 and 5. If you grind the external cutter first you will have no trouble with the internal. The cutter is made from 1/4-in. high-speed steel. It is necessary to use a 60-degree edged wheel or shape this same angle on a square-edge wheel as shown in Fig. 7. Fig. 6 shows how the blank is held against the wheel to cut the vee, which is the most important part of the grind. In use, set the cutter for a full depth-of-thread bite, and run the lathe between 50 and 100 r.p.m. If desired, the cut can be made in two passes. "Hairline" feeding should not be practiced, since this cutter needs a definite "bite" to do good work.

Shaper method: The shaper or milling method of thread cutting is pictured in Figs. 8 to 11 inclusive. The hand grinder or tool-post grinder used should be angled slightly to the axis of the work so that the tool will be in the clear, Fig. 9, the cutter being ground so that it will cut a 60-degree thread with grinder in

60° V-THREAD DIMENSIONS FOR WOOD

Nominal size	Threads per inch	Minor Diameter	Single depth of thread	Bore for internal	Pilot for wood tap	Wood tap thread dia.
3/8	10	.225	.075	.246	1/4	.397
	12	.249	.263	.267	—	—
	*16	.281	.047	.293	—	—
1/2	8	.312	.094	.339	5/16	.527
	10	.350	.075	.371	3/8	.522
	*12	.374	.063	.392	—	—
5/8	*13	.384	.058	.400	—	—
	8	.437	.094	.464	7/16	.652
	10	.475	.075	.496	1/2	.647
3/4	*11	.487	.069	.507	—	—
	*12	.499	.063	.517	—	—
	6	.498	.126	.534	1/2	.786
7/8	8	.562	.094	.589	9/16	.777
	*10	.600	.075	.620	—	—
	*12	.624	.063	.642	—	—
1	6	.623	.126	.659	5/8	.911
	8	.687	.094	.714	11/16	.902
	*9	.707	.084	.731	—	—
1-1/8	*12	.749	.063	.767	—	—
	4	.622	.189	.676	5/8	1.054
	6	.748	.126	.784	3/4	1.036
1-1/4	*8	.812	.094	.837	13/16	1.027
	*12	.814	.063	.892	—	—
	4	.747	.189	.801	13/16	1.179
1-1/2	*7	.909	.108	.940	15/16	1.156
	8	.937	.094	.964	15/16	1.152
	4	.872	.189	.926	15/16	1.304
1-3/4	*7	1.034	.108	1.064	1-1/16	1.281
	8	1.062	.094	1.089	1-1/16	1.277
	4	1.122	.189	1.176	1-3/16	1.554
2	*6	1.248	.126	1.284	1-5/16	1.536
	8	1.312	.094	1.339	1-5/16	1.527
	4	1.372	.189	1.426	1-7/16	1.804
2-1/4	*5	1.448	.151	1.490	1-1/2	1.793
	8	1.562	.094	1.589	1-9/16	1.777
	4	1.622	.189	1.677	1-11/16	2.054
2-1/2	*4 1/2	1.664	.168	1.711	1-3/4	2.048
	8	1.812	.094	1.839	1-13/16	2.027



How to Use Thread Chart

Nominal Size—Spindle dia. can be slightly less but never more than nominal size.

Threads Per Inch—Starred items are regular metal tap sizes. 8-pitch is recommended for spindles under 1 in. diameter; 4-pitch for work over 1 in. diameter.

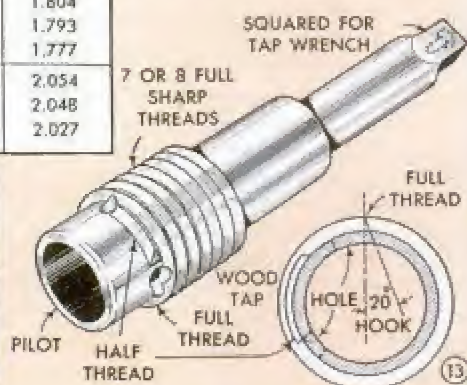
Minor Diameter—Use this column when necking down for shoulder threads.

Single Depth of Thread—Shows total amount of infeed required, the feed being straight in plunge cuts instead of conventional compound angle feed.

Bore for Internal Thread—This column gives bore of internal hole previous to threading operation with any style of sharp point 60° vee cutter.

Pilot for Wood Tap—Homemade wood taps should have pilots of this size.

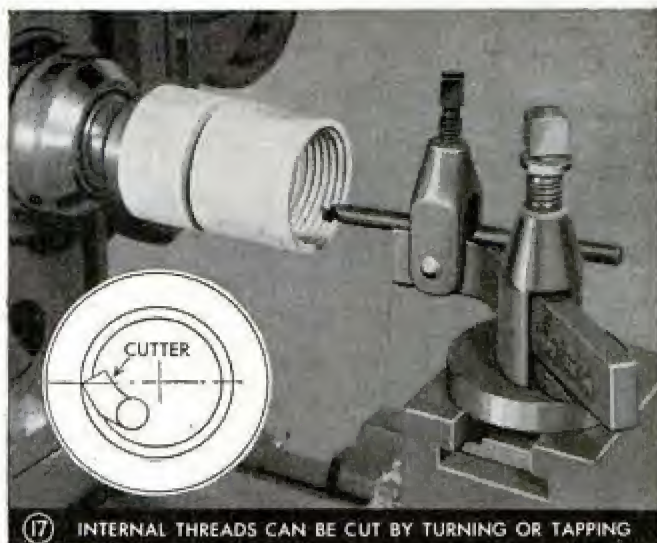
Wood Tap Thread Diameter—Major diameter of tap previous to turning full sharp point thread.



this off-angle position. The cutter is ground to proper profile shape while rotating in the lathe, Fig. 10, and then is backed off for clearance on the bench grinder. The tool isn't quite rugged enough to wade right into a 4-pitch thread or even an 8-pitch one. Two methods can be followed. Either set the cutter for a full thread and then turn the lathe slowly by hand with the thread feed engaged, or set the cutter for a light bite and run the lathe at 50 to 100 r.p.m. The direction of the lathe rotation is immaterial. With a heavy-duty tool-post grinder, the full thread can be cut in one pass with the lathe running.

V-thread dimensions: Follow the chart at left of Fig. 12 as a guide to thread sizes, especially when working mating parts. As a general rule, wood threads fit looser than metal threads to compensate for wood shrinkage or swelling.

Internal threads: Internal threads can be cut by tapping or by modifications of the methods already described. A tap for wood is shown in Figs. 13 and 14. It should be turned on the lathe, using any grade of mild tool steel; no hardening is needed. The blank should be shouldered at 60 degrees, Fig. 15, which will automatically establish the half thread needed for the first cutting point. The lathe can be turned by hand to further dress the half thread and remove surplus metal. The actual cutting points are made by spotting flats on the thread by grinding, and then drilling holes through the hollow pilot at a 20-degree hook angle as shown in Figs. 13 and 16. In addition to making the cutting points, the holes provide for chip disposal, hence should be made as large as possible without cutting into the crest of the next thread. The tap is used much the same as a metal tap, boring a hole for the pilot and then turning the tap in with a tap wrench, Fig. 18. As slight tearing of the wood may occur at entry and exit, it is advisable to clamp a block of wood on the work, Fig. 19, if the thread opening is a "show" surface. Wood taps of this kind do excellent work across the grain, but usually fail on end-grain threading. Fortunately, this condition seldom hampers actual work since end-grain threading usually indicates work of a size and shape that can be threaded in the lathe. However, where tapping of the end grain is necessary, a fair thread sometimes can be obtained by using a threaded block, Fig. 20, as a strain-lessening guide for the tap. The operation of cutting an internal thread with a tangent cutter is shown in Fig. 17, the cutter shape being very similar to the external cutter except that the top need not be raked back quite



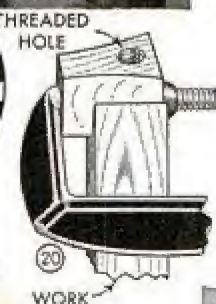
17 INTERNAL THREADS CAN BE CUT BY TURNING OR TAPPING



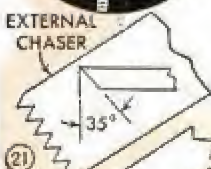
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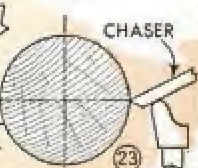
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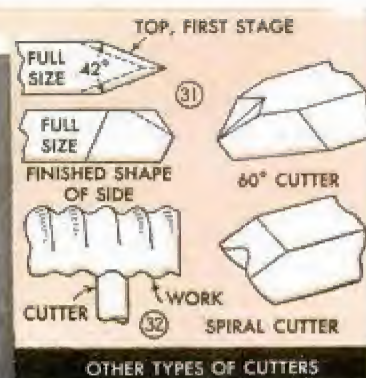
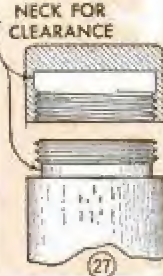
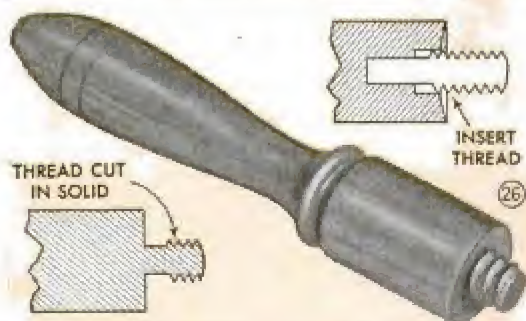
so much. Internally, the tangent cutter works best if the cut is taken in three or four equal bites.

Hand chasing: Lacking a lathe with lead screw, threads can be cut with hand-chasing tools. The metal for chasing tools should be good chisel stock, from $\frac{1}{8}$ to $\frac{1}{4}$ in. thick, depending on the coarseness of the thread. The cutting point is a series of from four to eight teeth ground to the proper shape and back-beveled about 35 degrees, Fig. 21. The simplest grinding method is



24

HAND CHASING IS NOT DIFFICULT IF DONE AT SLOW SPEED



to use an edged wheel, working the profile shape to that of a paper pattern stuck to the chisel and then backing off the heel for clearance. The operation of hand-chasing is shown in Fig. 24. The lathe must run at slow speed, not over 300 r.p.m. At speeds higher than this, it is very difficult to time the travel of the chisel, which obviously must be the same as the thread pitch. The tool should be angled down to bring the cutting points to the work centerline as shown in Figs. 23 and 24, while providing 10 to 15 degrees negative rake. The first bite is made by gently touching the chaser to the work and then moving it along toward the headstock at a speed proportionate to the pitch. This travel is aided by the fact that several teeth are in contact with the work. Repeated passes then are made over the work, concentrating on the deepening of the first five or six threads. It is good practice to have the work ten or twelve threads overlength, so that the starting threads, which may be imperfect, can be cut off. Internal threads are chased with a tool like the one in Fig. 22 in much the same manner, the tool rest being at right angles across the work opening and the chaser projected into the hole.

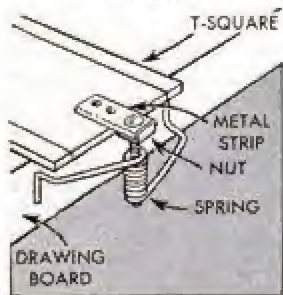
Screw boxes: Screw boxes in sizes from $\frac{1}{4}$ to 2 in. diameter spindle thread can be purchased at a nominal cost. The cutting principle of the screw box, Fig. 25, is similar to the tangent cutter as used on the lathe, the only difference being that the cutter turns around the work while being held in the screw-box frame. No particular skill is needed in using a screw box. Use firm pressure in starting the thread, after which the rear portion of the box, which is threaded, provides a positive guide for the following threads.

Cutting threads to a shoulder: One of the most important applications of wood threads is the shouldered thread found in tool handles, screw-top boxes and screw-on furniture legs. A simple practice suitable for some classes of work is to use an insert thread, Fig. 26, instead of cutting the thread in solid wood. The insert thread

can be tenoned, but also is quite practical if the whole thread is used as a dowel joint. Working in this manner, a length of thread stock can be made up and cut off as needed for various jobs. Cutting the thread in the solid is required for screw-top boxes, and the operation is quite simple if the thread shoulder is necked down to provide a space for disengagement of the lathe thread feed, as shown in Fig. 27. In making boxes, the lid is turned first, followed by the body, Figs. 28 and 29, after which the lid is screwed to the body for finishing cuts as shown in Fig. 30.

Other types of cutters: Two additional cutter shapes for use on the lathe are shown in Figs. 31 and 32. Fig. 31 is a good shape for a V-thread scraping tool. This cutter is presented radially to the work like a hand chisel, and should be fed in at the rate of about .010 in. per cut. The V-cut at the top of the cutter is run in last when grinding and can be cut on the corner of a square-edge wheel. The compound angle thus obtained will result in an actual cutting edge of 60 degrees despite the initial grind of 42 degrees. The box thread, Fig. 29, was cut with this cutter, and it is particularly useful for close-in, delicate work. Fig. 32 shows a spiral cutter worked on a 1/4-in., high-speed steel blank for a 4-pitch spiral thread. This cutter is used in conventional scraping position, the grind at top providing about 15 degrees negative rake. Because of the rounded surfaces there is no tearing. Properly shaped, the cutter will cut both external and internal threads. These cutters are scrapers and for best results, spindle speed should be as high as the nature of the work and mechanism of engaging thread feed allows.

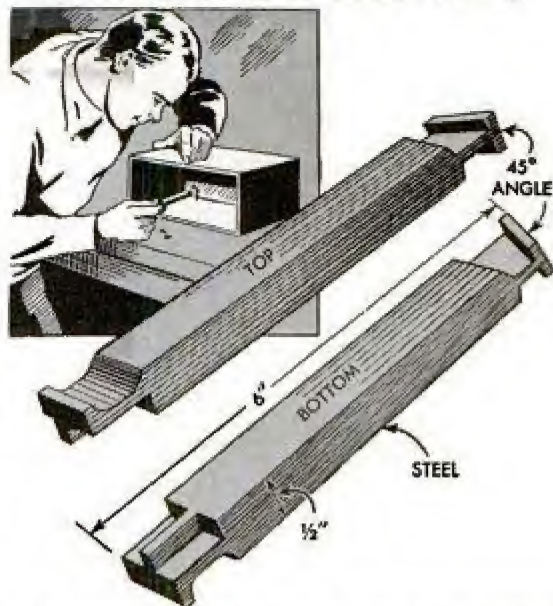
Spring Fixture Steadies T-Square On Drawing Board



This spring attachment steadies a T-square and is especially helpful when lettering instruments are being used with the square. A piece of metal with edges bent down to accommodate the nut is screwed to the edge of the square and drilled to take a bolt, which is turned in tightly. Spring wire, such as can be obtained from an old spring-type clothespin, shaped as shown and turned onto the bolt, completes the unit. By simply removing the screws, the unit can be taken off the square when desired.

—Corp. R. B. Nowak, Camp Davis, N. C.

You Can Get at Almost Any Screw With This Multi-Blade Driver



A mechanic who did a lot of assembly work designed this screwdriver, which has a number of blades each ground at a different angle, so that he could get at screws located in places difficult to reach with an ordinary screwdriver. The driver is made from a piece of 1/2-in. steel 6 in. long. If the angles of some of the blades shown are not suitable to your particular kind of work, they can be ground to suit.

—Opie Read, Jr., Chicago.

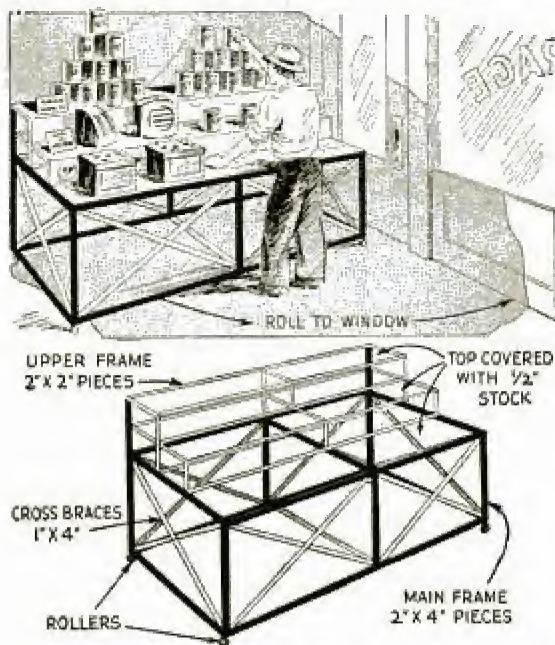
Radiator Hose Held by Guide Slips Into Place Easily

The job of replacing the water hose between the cylinder block and the radiator is made easier with a stiff wire bent to shape as shown. After the hose is cut to proper length, it is bent downward in a vise and the wire hooked on over the ends. When the hose is placed as nearly as possible in position, pull up on the wire, and the hose will be started on the connections so that it can be pushed into place by hand. The wire is easily removed.



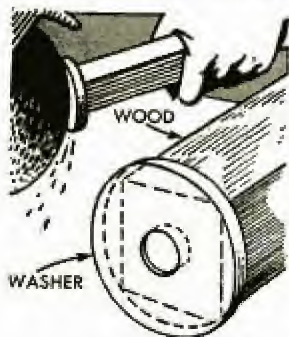
When drilling tubular rivets from metal the rivet will be less apt to spin with the drill if you hold the metal at a 45° angle and drill straight down. The rivet will fall out easily.

Trimming of Window Simplified With Portable Display Rack



Assembled from wood, this window display rack is fitted with casters and is constructed to provide a series of shelflike sections for supplies and appliances. It permits trimming a window merely by pulling it around to a convenient position and decorating the shelves, after which the rack is quickly and easily rolled back into place. The rack is of particular advantage in garages and stores where no space has been provided in the windows for holding merchandise.

Easy Way to Hold Metal Washers While Grinding Them



Having a number of washers that had to be ground down slightly to reduce their thickness, I did the job in the minimum of time by using this simple handle to hold them against the grinding wheel.

The handle was nothing more than a piece of wood, which had a short projection turned at one end to fit snugly in the washer holes. The handle permits holding the washers squarely against the grinding wheel with sufficient pressure to reduce their thickness quickly, and with little possibility of the wheel jerking them out of the hands.

—Claude J. Karcher, Easton, Pa.

Mottle Finish Easily Produced By Dipping Process

This mottle finish is ideally suited for tool and kitchen utensil handles, toys and similar small turned objects. The process calls for dipping the work in clear lacquer, and immediately redipping in a colored lacquer. By withdrawing the work from the colored lacquer in a series of jerks, definite color bands are circled around the work. The colored lacquer runs immediately after dipping, intermingling with the clear base coat to form a mottle finish while retaining a definite pattern of color rings.

Starting out, the work should be sanded smoothly and given a base coat of color lacquer applied by brush or spray, Fig. 1. This coat should dry overnight to assure a "bone-dry" base. The dipping requires two tanks, one for clear lacquer and the other for a lacquer enamel. Both clear and colored lacquers should be fairly thin, about the same consistency as for spraying, say, diluted half-and-half with thinner.

The work is held on a pin board or stick, is dipped into the clear lacquer and immediately withdrawn. It should drain for three or four seconds and then is lowered smoothly into the colored lacquer. Now, if the work is lifted quickly, a solid coating of color will be deposited. If the work is held stationary for a second and then lifted slowly, the color coat will break, exposing a clean band of the base coat. Again, if the work is jerked up quickly, it will take a solid coat of color. In this manner, various widths of color bands, delicately intermingled, are obtained. Typical color schemes are red over white, blue over silver, silver over blue, green over cream, etc. Less contrasty, black over dark red or dark brown over light brown produces an imitation of highly figured hardwood.

As this is a smooth finish, it must not show drips or runs even though the finish itself is based on the running of the lacquer. Therefore, the lacquers must be thin so that they will drain clean and quickly to a single bead at the bottom which is easily removed with a soft cloth or a piece of cleansing tissue. Control over the "run" is largely obtained by changing the viscosity of the initial clear lacquer coat. If the color coat runs too much, it is a sign that the clear lacquer is too thin; if the color coat does not break when the work is lifted slowly, the clear lacquer is too thick. Excellent practice in dipping and color control can be obtained by dipping a plastic rod or square. Since this has a fixed ground color it can be dipped and then wiped clean as often as desired until the technique has been mastered.



Attractive MOTTLE FINISH *by dipping*



After sanding work thoroughly, spray or brush the surface color coat (cream lacquer was used on the sample shown). Allow to dry overnight



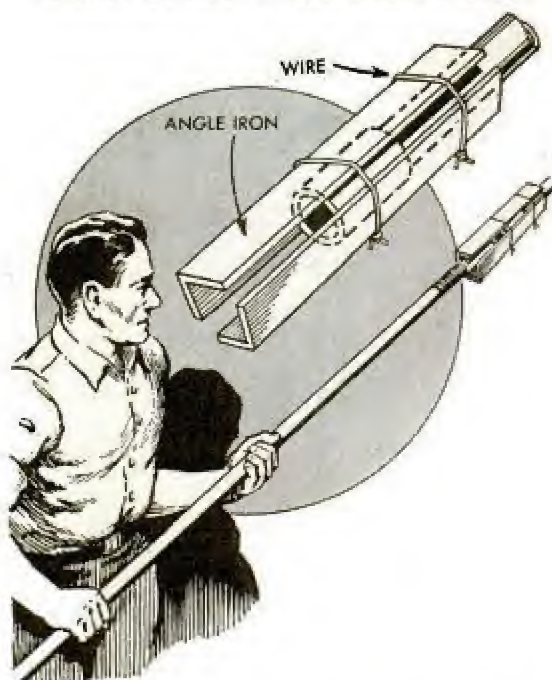
Dip work in clear lacquer, thinned about half-and-half as it comes from the can, or, at about spraying consistency. Lift quickly. Let drip about four seconds

Let work drain a few seconds and remove bead at bottom with soft cloth or tissue. Hang up to dry in same position as dipped



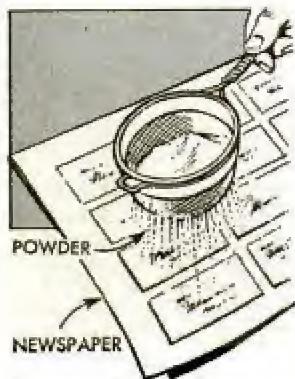
Immediately plunge the work into colored lacquer (the sample is blue). By lifting quickly, the work will take a smooth color coat (blue). If the work is held stationary for about one second and then lifted slowly, the color coat will break, showing a clear band of the base coat (cream). Again lifting quickly, the work will take a solid coat of blue. Repeat the banding process as often as desired

Coupling of Long Pieces of Pipe Done Easily With This Guide



If you have to couple some long pieces of pipe single-handed and have a difficult time in getting the threaded ends of the pipes started into the couplings, rig up a simple guide like the one shown. It is nothing more than two lengths of angle iron bound around the coupling end of the pipe with wire. When the loose piece of pipe is inserted into the opening formed by the angle iron, it is guided into the coupling, thus making it easy to engage the threads and start them straight.

Printing Raised Lettering On Small Jobs



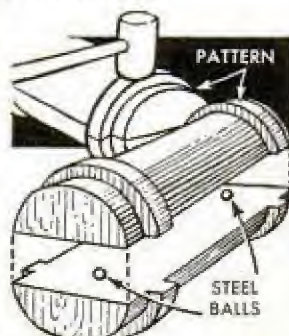
Printers who receive occasional jobs that require the use of the popular raised printing effect, but who do not have the special equipment to handle such work, will find the following method a time-saver. Spread the printed work out face up on a newspaper, and use a fine-screen coffee strainer to dust the resin powder over the printing. Then pick up the cards or envelopes, jar the excess powder off onto the newspaper, and lay them out on a large window screen. Pass the screen slowly over an electric hotplate to

raise the printing. The powder left on the newspaper is put back into the strainer to be used again.

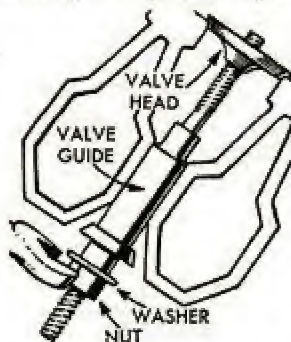
—Francis L. Tyler, Penn Yan, N. Y.

Locating Dowel Holes in Split Foundry Patterns

When you have to make a split wood pattern for use in foundry casting, here is an easy way to locate the holes for dowels that hold the pattern together. Place two small steel balls on one half of the pattern at the desired locations for the dowels. Then carefully place the other half of the pattern in position and tap it lightly with a hammer. This will cause the balls to make small indentations in the wood which will then serve as guides in drilling the dowel holes.



Easy Way to Replace Valve Guides

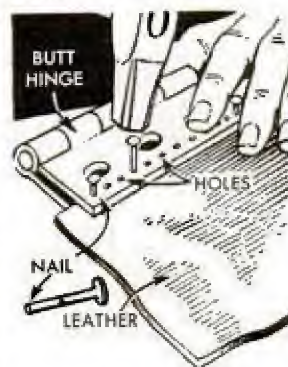


On many gasoline engines the job of installing new valve guides can be simplified with the improvised tool shown. To make the tool, cut off the head of an old valve and drill and tap it to take a length of rod that is threaded at both ends. In use, insert the tool just like a valve, start the guide in place and then drive a nut and washer on the lower end. This will force the guide into place.

—Ivan J. Stretten, Detroit, Mich.

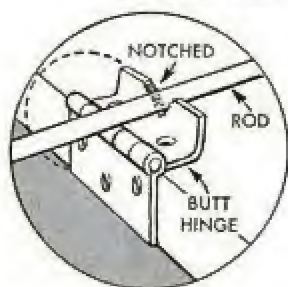
Lacing Holes Punched in Leather By Using Hinge as a Die

The next time you want a number of uniformly spaced holes in leather to lace it together, try using a butt hinge as a die and a nail as a punch. Drill a row of small holes through both halves of the hinge near their edges,



drilling through both halves at the same time so that the holes will correspond in both parts. Then grind off the end of a nail square, using one that is a fairly snug, sliding fit in the holes. In use, place the leather between the two halves of the hinge as indicated, clamp it in place, and then drive the nail through each hole in turn.

Holder to Steady Small Rods While Sawing Them

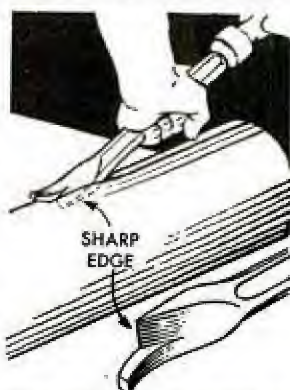


To facilitate holding small rods and dowels while sawing or filing them, one mechanic uses a hinge screwed to one edge of his workbench. When not in use, the hinge is flipped

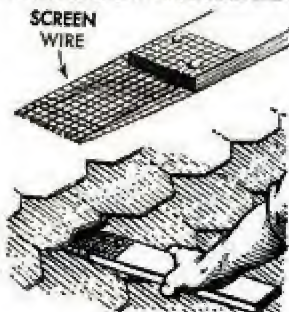
down out of the way. The free half is bent at right angles in the center and the upper edge is notched, the edges of the notch being serrated with a file to form small teeth that aid in preventing the work from turning as it is being sawed.

Special Chisel to Cut Sheet Metal

Most of the usual troubles encountered in cutting sheet metal with a cold chisel are avoided when a chisel shaped like the one shown is used. A straight line can be followed easily with the chisel and there is no danger of it slipping off the work. It can be shaped from a regular chisel, or it can be made up from a piece of suitable metal.

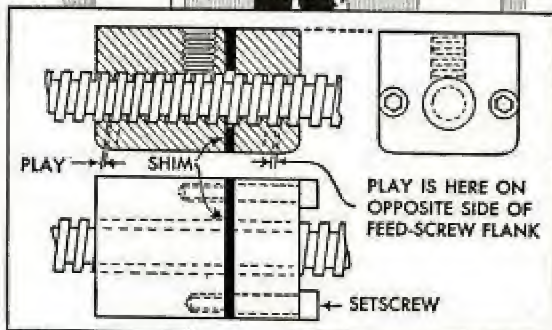


"Brush" for Cementing Shingles Made From Lath and Screen Wire



Folded and tacked to a lath, a strip of screen wire can be inserted between composition shingles for recementing them, if the proper taper brush is not at hand.

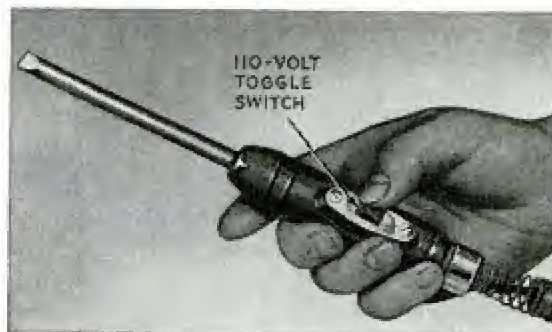
Worn Nut on Cross-Feed Screw Of Lathe Repaired Easily



When the threads of a cross-feed-screw nut on a lathe became badly worn and allowed too much play, an emergency repair was made as shown. First, the nut was drilled and tapped lengthwise for two setscrews, after which the nut was cut in two. Then, the two parts were turned back on the cross-feed screw and shimmed apart so that the threads in both parts of the nut pressed snugly against the threads of the screw. After inserting and tightening the setscrews, all play in the threads was taken up and the nut was as serviceable as a new one. —Emil Wittman, Philadelphia, Pa.

Snap Switch in Soldering Iron Gives Close Heat Control

Having considerable work that required intermittent use of a small soldering iron that had to be kept hot ready for instant use, one mechanic put a switch in the iron handle so that it could be turned off easily for short intervals. The switch was of the 110-volt snap-action type used frequently on radio panels.



HEAT TREATMENT

By
H. J. Chamberland

metals to which heat treating is applied are known as carbon and alloy steels, or the steel from which they are to be made. However, many other materials also are subjected to heat treating in some form or other.

Heat-treating furnaces: These are of two distinct constructions—the muffle or box-type shown in Figs. 1, 3, 4 and 5 and the pot or crucible type shown in Fig. 2. Both of these types of furnaces can be used for all the variations of heat treat-

ment referred to in the preceding paragraph, although many industrial plants use separate furnaces for separate steps of the process. Source of heat can be natural gas, manufactured gas, oil or electricity. With a muffle or box-type furnace, the heat treating is done directly by the heat that is produced within the chamber, but with the pot or crucible type of furnace, the part or parts to be treated are immersed

REGARDLESS of how accurately and nicely finished a die, twist drill and even your screwdriver or hack-saw blade may be, these tools would be of little value if they had not been heat-treated properly. When speaking of heat treating in general, such procedures as hardening, tempering, annealing, forging, normalizing and carburizing are included. Also, the



2—POT-TYPE, ELECTRICALLY HEATED FURNACE WITH BUILT-IN THERMOCOUPLE
3—GAS-HEATED MUFFLE FURNACE USED CHIEFLY FOR TEMPERING

of STEEL

*Tempering
Hardening
Annealing
Forging
Normalizing
Carburizing*



THE MUFFLE-TYPE FURNACES SHOWN ABOVE ARE HEATED AND CONTROLLED BY ELECTRICITY

in a red-hot lead or salt bath. Depending on the insulation qualities, high temperatures may be reached with both types of furnaces, although pot furnaces are used often to melt metals only, and are therefore called crucibles. Heat-treating furnaces are made in many sizes ranging from monstrous installations for battleship guns to small laboratory models used for delicate parts of scientific instruments and experimental work.

Hardening: Purpose of hardening is to impart certain physical properties to steel so it will resist abrasion (wear), will have tensile strength (resist straining or stretching) and impact strength (to stand blows). The degree of heat and the period of heating applied in each case depend on the type of material, the shape and size of a part, and the purpose for which it is to be used. The hardening procedure consists of heating the part or parts to a predeter-

mined temperature for a predetermined length of time. The temperature at which steel will harden most efficiently is called the critical temperature or point of recalcence. Often it is heated somewhat over this stage, removed from the furnace and quickly immersed in a tank of liquid such as water or brine maintained at a temperature of 60 to 80 degrees F. This is known as the quench. Some types of steel are quenched in oil, while others are cooled in still air.

Tempering: All tools or pieces of steel that have been heated to high temperatures and immediately quenched have developed internal strains. When exposed to sudden changes in temperature, the steel is likely to crack unless these strains are relieved by the heat-treating procedure known as tempering, also called drawing. It consists of reheating the steel to a comparatively lower temperature than that



6—WIRE BASKET USED TO LOWER PARTS IN QUENCHING BATH. 7—QUENCHING BATH AND CARBURIZED PARTS DUMPED INTO CHUTE



applied for hardening. This temperature may range from 300 to 600 degrees F., depending on the degree of hardness desired, or it might even go beyond this point. The furnace shown in Fig. 3 is designed particularly for the purpose of tempering, and the heat cannot be increased for hardening. Work taken from a tempering furnace should not be cooled in a quenching liquid but should be cooled in still air.

Annealing: After steel has been made at the mill it is not in a machinable state due to its extreme hardness, and therefore it must be softened or annealed, which is generally done at the mill. However, steel often must be annealed by the user after it has been hardened. Annealing is done in a hardening furnace, the work being subjected to a temperature of from 15 to 100 degrees below the critical point. Annealing demands a slow and increasing heat, and the work may be cooled in the furnace after shutting off the heat, or in still air, but never quenched.

Forging: Steel cannot be shaped by hammering unless it is thoroughly heated to a forging temperature. Parts to be forged also must be heated slowly to the required temperature which is usually from 200 to 350 degrees above the critical point. After removing the steel from the furnace, it is cooled in still air, all air currents and dampness being avoided.

Normalizing: Normalizing is a process quite similar to tempering but applies particularly to work that has been forged. As a general rule, steel sufficiently annealed at the mill requires no normalizing, but if it has to be done to relieve excessive forging strains, the required temperature is from 50 to 75 degrees F., above the critical point.

Carburizing: Carburizing is a heat-treating process whereby the use of certain special gases introduces an extra amount of carbon in low-grade steels so they can be used as substitutes for more expensive steels. This is a surface-hardening procedure. The resulting carbon content and depth of hardening or "case," as it is called, will depend on the gas mixture, type of equipment and heating time. Work to be carburized must be machined to dimensions, yet allowances for ground finishes can be made by estimating and controlling the depth of case, which may be $\frac{1}{16}$ in. and over. If the work is executed properly, the result is a uniform glass-hard exterior section with no effects on the core or internal structure of the steel. When this is done in large quantities, carburized parts and also the quench bath are dumped as shown in Fig. 7. A fresh quenching solution is used for each batch of heated parts, the used quench having

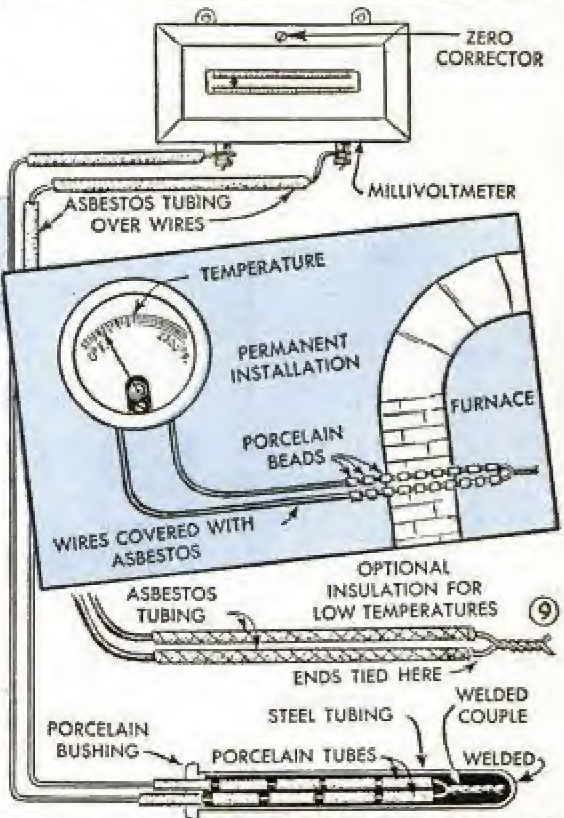
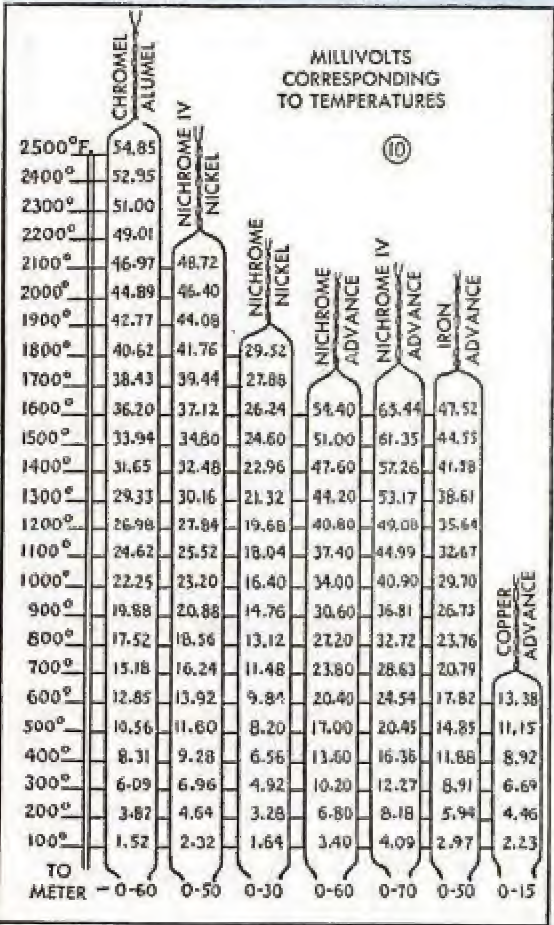
been heated to the point where it cannot be re-used. Fig. 6 shows parts held in a wire basket to be submerged in a quenching tank. Carburizing is not the only form of surface hardening. Nitriding is a similar process using ammonia gas as a treating agent. Also, there are other patented processes. The use of a cyanide bath is well known when a shallow case is desired.

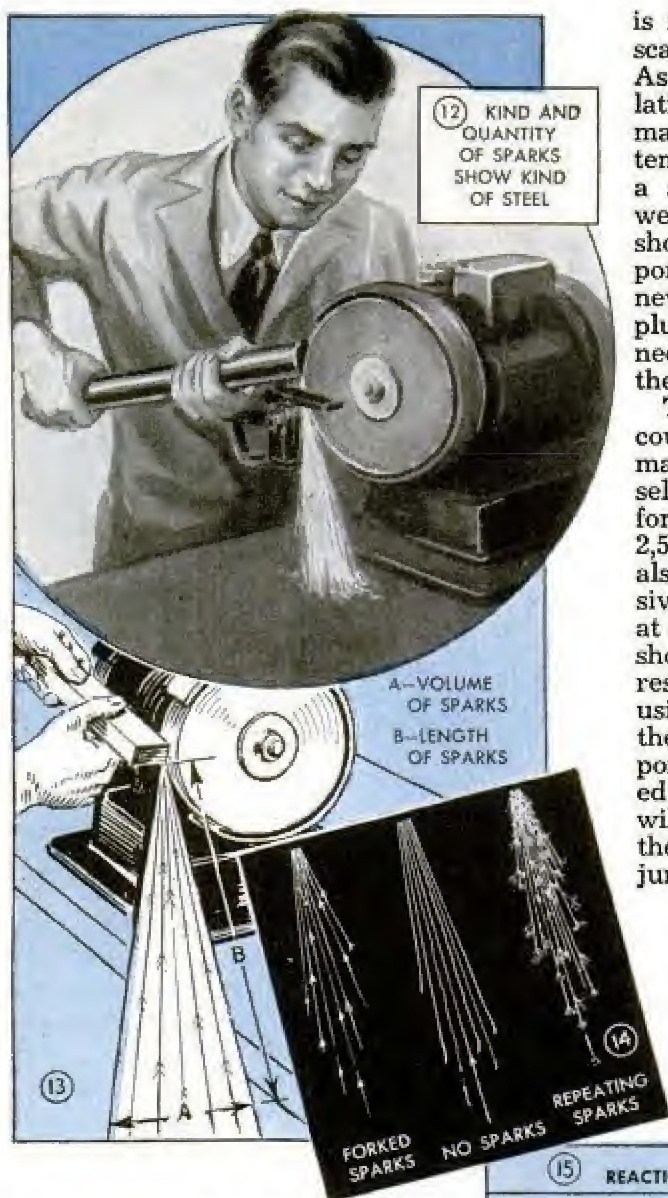
Flame-hardening is not new but still receives a great deal of attention where resistance to wear is the main objective. Induction hardening is the most recent form of surface hardening. This is accomplished by placing the work inside a magnetic field set up by an inductor coil which carries high-frequency currents. The heating and quenching cycle is but a matter of seconds.

A cold-treating furnace, shown in Fig. 8, is a carbon-dioxide refrigerator in which the temperature can be reduced to 120 degrees below zero, F. Such a cold-treating furnace is used in connection with a tempering furnace to stabilize the steel used for precision tools and instruments, and



8—COLD-TREATING EQUIPMENT OPERATES AT 120 DEGREES BELOW ZERO, FAHR. 9—DETAILS OF THERMOCOUPLE PYROMETER CONSTRUCTION. 10—VARIOUS COMBINATIONS OF THERMOCOUPLE WIRES SUITABLE FOR DIFFERENT TEMPERATURE RANGES. 11—TESTING HARDNESS OF STEEL





to offset the effects of subsequent temperature changes.

Thermocouple pyrometers: Nearly all heat-treating furnaces are equipped with thermocouple pyrometers, and many have automatic heat controls, which makes them highly efficient. Thermocouple pyrometers consist of two lengths of wire of different metals or alloys, separated from each other except at one end, which is securely twisted then welded or brazed so both metals will unite. The free ends of the wires are connected to a direct-current millivoltmeter as detailed in Fig. 9. The welded end is inserted where temperature is to be measured and the heat at this end causes a difference in electric potential, which

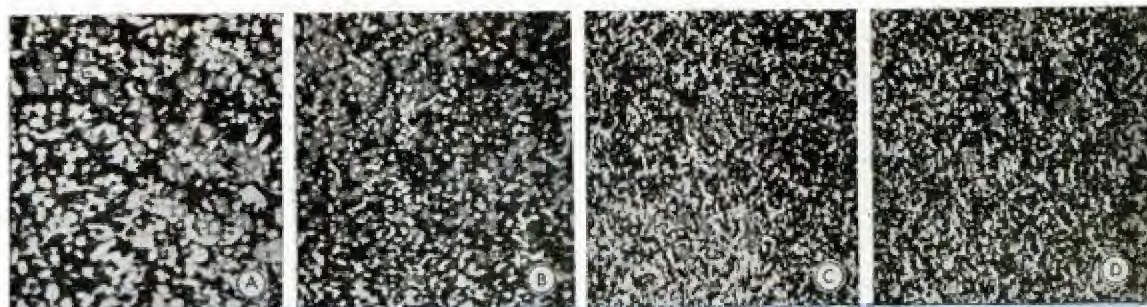
is indicated on the millivoltmeter, the scale of which is calibrated in degrees. As will be noted from Fig. 9, the insulation on the wires near the welded end may be asbestos tubing if used for low temperatures, but porcelain tubes and a steel jacket protect the wires and welded end from high temperatures as shown in the lower detail of Fig. 9. The portion subjected to heat must be renewed occasionally, and therefore a plug enabling this portion to be disconnected conveniently from the leads to the millivoltmeter is generally provided.

Those who wish to renew the thermocouple themselves will find the information in Fig. 10 convenient in order to select pairs of wires of different metals for various temperature ranges up to 2,500 degrees F. All thermocouple metals except platinum and some expensive alloys melt or cease to be sensitive at about this temperature. Fig. 10 also shows millivoltmeter readings which result at various temperatures when using the wires listed. When renewing thermocouple wires it is of utmost importance that the twisted ends are welded so that the metal from both wires will flow together. However, burning the wires must be avoided as a burned junction will be weak and will not give

accurate temperature readings when connected to the millivoltmeter. If, when connected, the meter hand tends to go in the wrong direction, reverse the connections.

Hardness testers: Degree of hardness of a heat-treated part is measured with instruments such as

(15) REACTION OF VARIOUS METALS TO SPARK TEST				
MATERIAL	STREAM		SPARKS	
	Volume	Color	Quantity	Nature
Machine steel	Large	White	Few	Forked
Wrought iron	Large	Straw	Very few	Forked
High-speed steel	Small	Red	Extremely few	Forked
Carbon tool steel	Moderate	White	Very few	Fine-repeating
Gray cast iron	Small	Red	Many	Fine-repeating
White cast iron	Very small	Red	Few	Fine-repeating
Manganese steel	Moderately large	White	Many	Fine-repeating
Stainless steel	Moderate	Straw	Moderate	Forked
Tungsten-chromium die steel	Small	Red	Many	Fine-repeating
Tungsten carbide	Extremely small	Light orange	None	—
Nickel	Very small	Orange	None	—
Copper	None	—	None	—
Brass				
Aluminum				



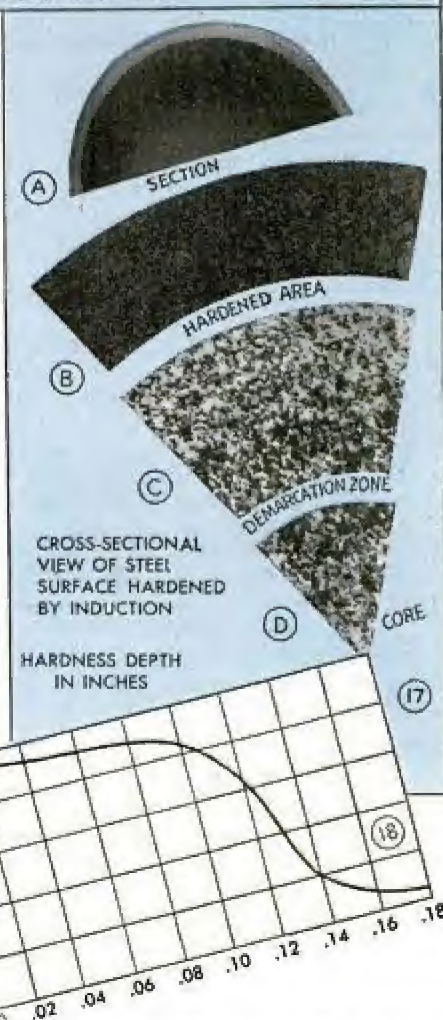
16 PHOTOMICROGRAPHS OF STEEL STRUCTURE IN PROCESS OF HARDENING FROM RAW MATERIAL TO THE DIAMOND-HARD STAGE

Rockwell or Brinell hardness testers, one of which is shown in Fig. 11. While both readings give similar results, the instruments are calibrated differently, as for example 65 on a Rockwell C scale equals 652 Brinell reading or 90 Rockwell B scale is 202 Brinell.

Classifying steel by spark tests: Steel is a critical material and a certain type mistaken for another can prove very costly, especially when heat treated. Spark tests, illustrated in Figs. 12 to 14 inclusive, provide an easy, reliable means of identifying steel. Any size grinding wheel of 46-P aluminum oxide, operating at the correct surface speed, will do. A portable grinder is ideal as it can be carried to the material. The testing is done preferably in total darkness, but a dim light is suitable if a black cardboard is placed behind the wheel to serve as a background. Dress the wheel face clean with an abrasive stick, using light pressure. The color and pattern of sparks based on the width and length of the stream, Fig. 13, determine the kind of steel or other metal. Not only do sparks vary in quantity but also in pattern, as shown in Fig. 14. Fig. 15 gives reaction of various metals to the spark test. Note that wrought iron and high-speed steels give very few sparks, and some produce none.

Hardened steel structures: The four photomicrographs of Fig. 16 show the transition which occurs in steel structures hardened throughout, from the raw material to a diamond-hard stage. In A, the white dots (known as cementite) are uniformly distributed because this is raw steel. In B, sufficient heat has been applied to partially break up the dots, while in C, additional heat has caused a wider distribution of the dots, and at this stage the steel has become quite hard. In D, the dots are so finely distributed that they appear like fine diamonds set into a matrix of steel. At this final stage, preceding quenching, the hardness is at its maximum, and tempering for a set period brings it down to the required Rockwell or Brinell figure.

Fig. 17 shows a structure resulting from induction surface hardening; the cross-sectional pattern varies with the procedure, but the hardened area itself differs slightly. Detail A shows the depth of hardening or case as it appears to the naked eye, while



B, C and D are highly magnified views from the outer surface to the core. The graph given in Fig. 18 shows the hardness depth in inches.

The three steel blocks in Fig. 19 show the differences in surface finish as produced under varying atmospheric conditions. A was hardened in a furnace having no control of any kind, B in a furnace having only heat control and C in a furnace having both atmosphere and heat control. C apparently has the finest grain as decarbonizing was entirely eliminated.

Tool steels: These are intended for use as tools to cut or otherwise alter the shape



(20)

HEAT-TREATING RECOMMENDATIONS

Key to abbreviations: C—carbon, Mn—manganese, Si—silicon, Cr—chromium, V—vanadium, W—tungsten, Co—cobalt, Mo—molybdenum

CARBON STEEL

Analysis: C .70-1.30 Mn .25 Si .22

Hardening	Tempering	Forging	Annealing
1425-1550	300-600	1600-1900	1375-1450

Quench—water or brine

HIGH-SPEED STEEL

Analysis: C .75 W 12.00-18.00 Cr 3.80-4.20 V .95-1.15

Hardening	Tempering	Forging	Annealing
1850-2300	400-1100	1950-2200	1500-1650

Quench—oil

HOT-WORK STEELS

Analysis: C .45 Mn .25 Si .30 W 12.00 Cr 3.50 V .75

Hardening	Tempering	Forging	Annealing
1750-1900	900-1100	1500-2000	1450-1650

Quench—oil or still air

SHOCK-RESISTING STEELS

Analysis: C .45 Mn .25 Si .30 W 1.75 Cr 1.40 V .25

Hardening	Tempering	Forging	Annealing
1550-1800	350-700	1700-2000	1400-1500

Quench—oil

DIE STEELS

Analysis: C .45 Mn .25 Si .30 W 1.75 Cr 1.40 V .25

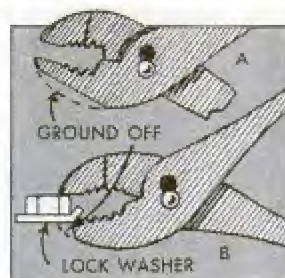
Hardening	Tempering	Forging	Annealing
1500-1650	375-500	1650-1800	1500-1550

Quench—oil

of other materials. Carbon steels have long ago been replaced with alloy steels but all contain a certain percentage of carbon. The most commonly used alloy tool steels are high-speed, hot-work, shock-resisting and die steels. Alloys generally used to make them are manganese, silicon, chromium, vanadium, tungsten, cobalt and molybdenum as given in Fig. 20. Molybdenum is substituted for tungsten when the latter cannot be obtained. In the case of high-speed steel the tungsten content is reduced from 14 to about 2 percent, but a proportional increase in molybdenum preserves its cutting properties. Die steel, used for all kinds of die and punch work, has a large percentage of carbon and chromium but no tungsten.

Adjustable Utility Pliers Cut Off For Use on Special Jobs

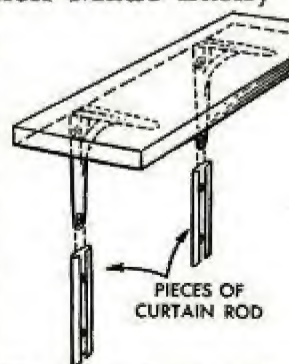
A pair of inexpensive adjustable pliers of the utility type can be converted easily for use as a pair of battery pliers by grinding off one jaw as shown in the upper detail.



This allows the nut on a battery-terminal bolt to be turned without the lower jaw of the pliers digging into the battery top. By grinding off the end of one jaw as shown in the lower detail, the same kind of pliers can be used for bending the lock washer to lock the nut on a Bendix bolt used on some generators and starting motors.

Detachable Shelf Made Easily

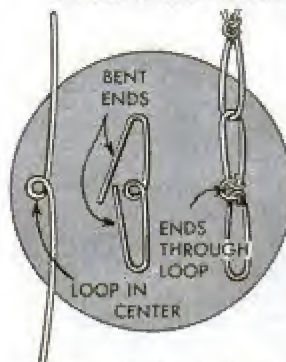
Requiring a shelf in my shop that could be removed when not in use, I made one as indicated. Ordinary metal shelf brackets were screwed permanently to the shelf and were slipped into short pieces of flat curtain rod



screwed to a wall. The nails that hold the pieces of curtain rod must be driven in flush with the surfaces of the rods.

—G. E. Henderson, Argyle, Wis.

Strong Looped-Wire Chain Links Will Not Come Unfastened



You can make small wire halter chains, dog chains, etc., with links as strong as the wire itself by cutting the wire in equal lengths that are twice as long as the finished link desired. To form the links, turn a small loop in the center of the wire and double back the ends so that they overlap slightly. Bring each free end up through the loop and wrap it around the side wire to complete the link, which is then drawn tight to close the loop.—Emil Eichler, Edmonton, Can.



Radio

"DON'TS"

FOR your own safety, and in the interest of your radio serviceman who is literally swamped with repair work, the following timely "DON'TS" illustrate things you must NOT DO if you expect uninterrupted enjoyment from your radio:

(1) Perhaps the most dangerous place in the home to operate a radio receiver is in the bathroom. Like any electrically operated device it should not be handled with wet hands, and the operator must not be in contact with water or grounded bathroom fixtures. Confined air, saturated with steam and talcum powder, is definitely bad for the set.

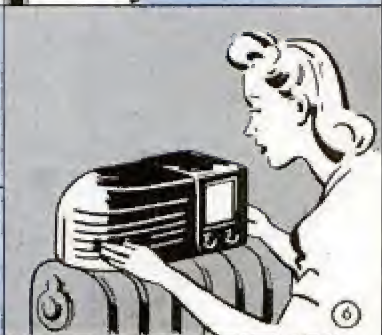
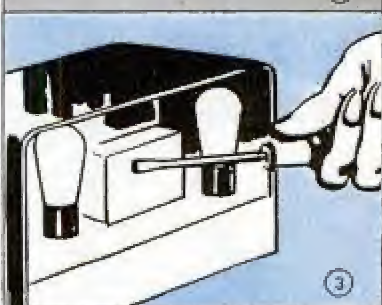
(2) Never attach a ground wire to your receiver unless directions specifically call for one. Do not connect the antenna wire to a radiator; such connections can result in a burned-out coil in the set.

(3) Do not use a screwdriver on the metal radio chassis, you may damage your set so that it cannot be repaired and you might get a serious shock.

(4) Never turn the turntable of a radio-phonograph combination by hand; forcing may bend or break the mechanism. Do not touch the pickup arm while the instrument is in process of changing records.

(5) Keep small radio sets out of windows, especially in the kitchen where you may be tempted to tune the set with one hand in water, a highly dangerous thing to do. Receivers kept in windows where they are subject to quick changes in temperature, and exposed to dampness, are regular patients in radio hospitals.

(6) This illustration should not be necessary, but any serviceman will tell you that it does happen, and he probably can show you table model sets that have been "fried" on radiators. All of these things cause unnecessary service calls, and can be avoided.

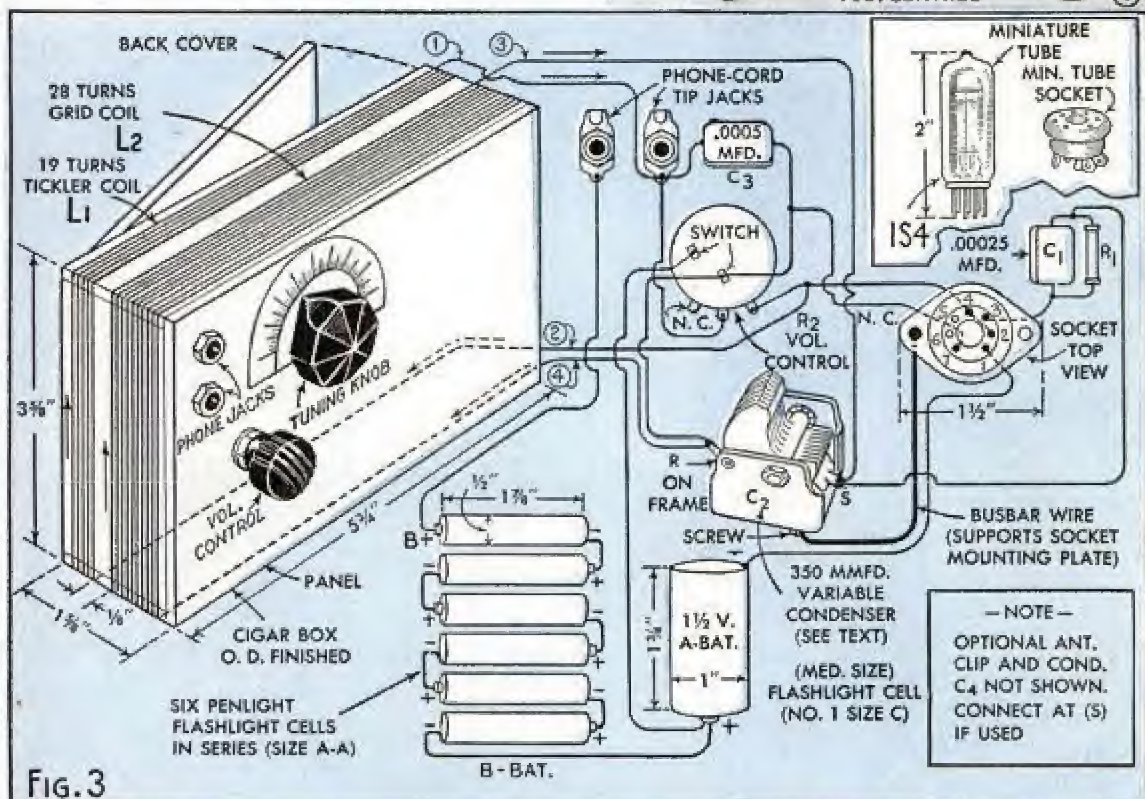
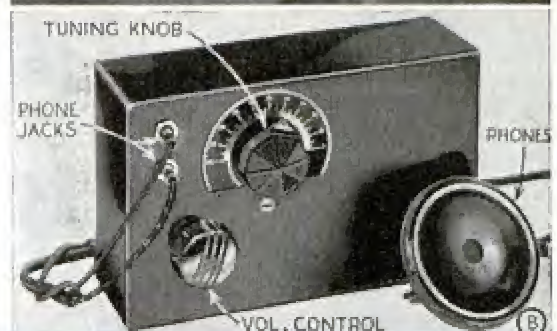


HAS BUILT-IN ANTENNA ...

or an old audio transformer. The case dimensions are given in Fig. 2, and all coil and circuit connections are clearly shown in the pictorial wiring diagram, Fig. 3.

The coil terminals are brought into the case through small holes, and these leads should be left long enough for the circuit connections. These coils will tune from approximately 575 to 1350 kc. If your local station, or stations, tune near 550 kc., add 3 turns to the grid coil winding. Wrap a layer of adhesive tape over each coil, sealing it down to the box, overlapping the coils to protect them from moisture. The case, including the cloth-hinged lid, is then covered with black oilcloth glued to the box with a layer of household cement. Detailed student material list R-326 is available from Popular Mechanics radio department, upon receipt of postage.

Arrange the parts carefully and wire them with short flexible leads before mounting them as shown in photo A. Cement the variable condenser dial plate on the case as indicated in photo B. Connect the six "penlight" B-batteries in series with flexible leads, and insulate the end of the $1\frac{1}{2}$ volt flashlight-cell A-battery from the terminals of the tube socket with a small piece of cardboard.





Practical RADIO HINTS

(A) Plastic crochet needle of the "dime" store variety makes a useful probe and wire-lifting tool for radio instructors or servicemen when demonstrating or locating poorly soldered or broken leads in "live" circuits under test. It provides a completely insulated tool better adapted for the purpose than a screwdriver or similar instrument that may cause a short circuit or an accidental shock to the operator



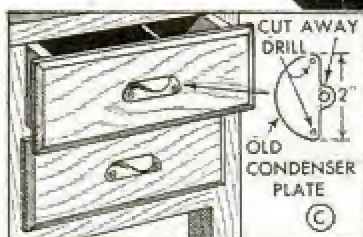
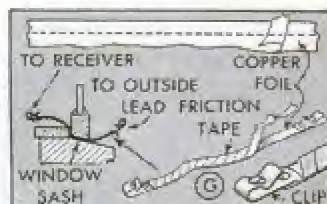
(B) A "china" marking pencil is used to write service data on glass or metal tubes in a large radio station where 50 receivers are operated on a 24-hour schedule. Home set owners will find this method better than the usual unsatisfactory gummed paper tube stickers for service memoranda and dating purposes

(C) Plates removed from a discarded variable condenser make good drawer handles for your radio workbench

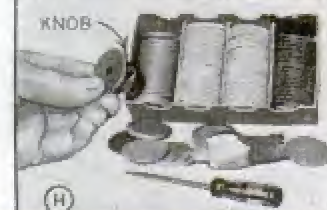
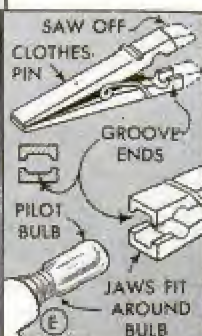


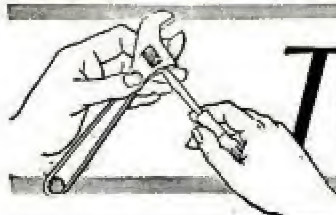
(G) Antenna lead-in strip made from paper-covered copper foil obtained from scrap building material. Fahnestock clips are bolted to each end; the strip is then carefully wrapped with weather-proof tape

(H) Tuning knobs with broken edges repaired with poker chips drilled and cemented as shown



(D) Microphone for inter-office systems has control box with "busy signal" light; (E) Handy pilot light remover made from spring clothespin; (F) Improved long-life phono needle has plastic noise-reducing insulator; (J) Scratch preventer shields tacked or cemented behind control knobs



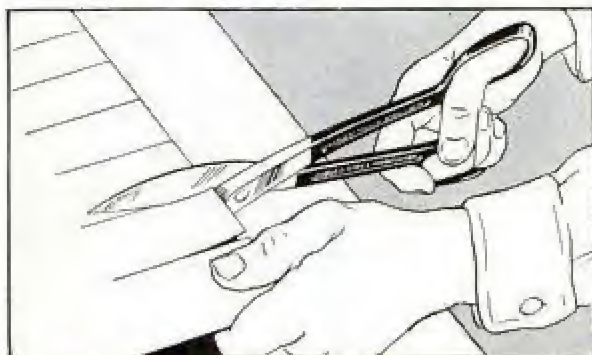


TOOL NOTES

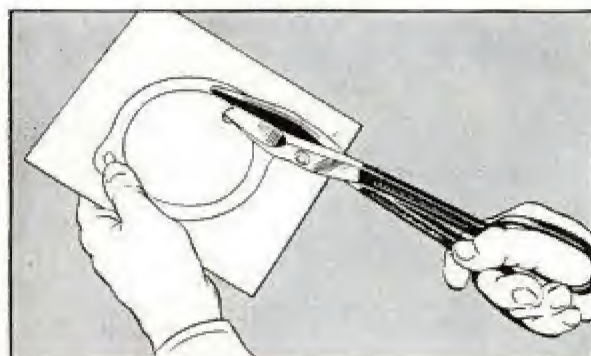
Maintenance
and Repair
Suggestions to
Prolong Tool Life

No. 17 PICKING THE PROPER TOOL FOR THE JOB

There is a difference in snips. They vary in style and size in order that they may better handle a wide range of cutting work. Below are some common examples.



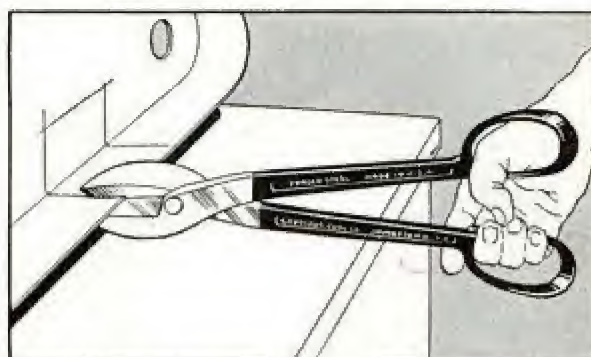
For general cutting use, **STANDARD PATTERN CRESCENT SNIPS** are recommended. Made in 8 sizes, they are designed to cut straight lines or circles of fairly large radius. Example: Cutting sheet metal to size.



Where it is necessary to cut intricate patterns or curves of small radius, use **CRESCENT CIRCULAR CUTTING SNIPS**. The curved contour of their cutting edges makes it possible to turn the cut sharply without taking a new "bite." Example: Cutting intricate templates.



When "on-the-job" work will not permit an assortment of snips being carried, use **CRESCENT COMBINATION SNIPS**. They are designed after conventional circular cutting types and will cut curves as well as straight lines. Example: Hot air furnace work.



Where powerful leverage is necessary, as with heavy sheet metal, **CRESCENT HEAVY DUTY SNIPS**—with an overall length of 16¼ inches—are ideally suited. Example: Heavy bench work.

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This is No. 17, in Crescent's **TOOL NOTES** Series. These informative advertisements provide practical information for users of hand tools. Mail the coupon today!

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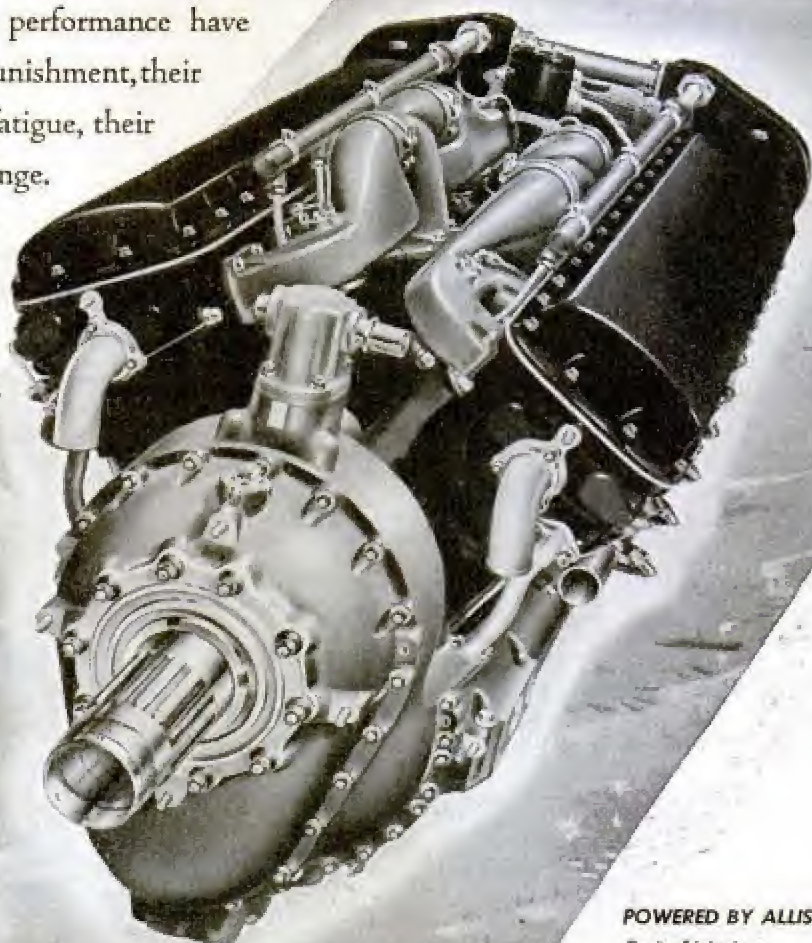
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WORTHY WEAPON

America's fighter pilots using Allison-powered planes are downing the enemy on every battle front. ★

Allison engines by superb performance have proved their ability to take punishment, their smoothness to lessen pilot fatigue, their economy to provide long range.

★ These engines—worthy weapons today—will contribute to the comfort and safety of the planes you will ride in tomorrow.



POWERED BY ALLISON:

P-38—Lightning
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More than 50,000 Allison engines have been built for the above planes of the U. S. Army Air Forces.

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What a pleasure to drive a car that has MARFAK chassis lubrication. Your car is quieter, smoother, easier to handle. MARFAK is always applied by chart, never by chance. Eliminates the possibility of missing a king pin or a control arm lubrication fitting. And with each MARFAK job you get a stem-to-stern check-up of every point of wear, every point of adjustment. Your Texaco Dealer turns your car out feeling years younger! Ask him to give your car that "MARFAK feeling"—tomorrow!

THE TEXAS COMPANY.

Let us
MARFAK
your car



TUNE IN: FRED ALLEN every Sunday night.
See your local newspaper for time and station.



"One of the Freedoms I will feel I have earned will be to have a Harley-Davidson under me again"



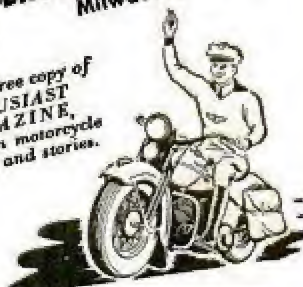
No letter, among the thousands we have received, is more typically American than this one from Seabee "Lefty" C—

"When I was a civilian, I had a Harley-Davidson. Its performance was superb. Have shore duty here with the Navy Seabees. Harley-Davidsons are used for specialized duties, and they never balk on the most rugged assignments. One of the freedoms I will feel I have earned will be to have a Harley-Davidson under me again and feel the good old American wind biting my face."

Many thousands of motorcycle fans feel the same way, Lefty. Like you, they are earning their freedoms — the hard way. You're all hastening the return of gypsy tours, race meets, hillclimbs and endurance runs. And we can assure you that when those "freedoms" are yours again, the newer, better Harley-Davidsons will really have what it takes to make the good old American wind bite your face! Put every spare dollar into War Bonds — thrill to your own Harley-Davidson after Victory!

HARLEY-DAVIDSON MOTOR CO.
Dept. P, Milwaukee 1, Wis.

Write for free copy of
ENTHUSIAST
MAGAZINE,
filled with motorcycle
pictures and stories.



HARLEY-DAVIDSON
MOTORCYCLES

Silver Goes to Work

Continued from page 75

which specialize in its production. Silver also should be considered one of the most corrosion-resistant metals that we have.

"Bactericidal properties of silver have attracted considerable attention in the purification of drinking water. The germicidal value of silver leaf for preventing infections by placing it over the incision after a surgical operation long has been known."

The purity of silver is referred to as the "fineness" of the metal, and a bar that contained 99.95 percent pure silver would be designated 999.5 fine, meaning 999.5 parts per thousand were silver. In the United States the standard silver acceptable for bullion trading is 999.0 fine and is referred to as fine silver. In England and the Orient, bars 996.0 fine are acceptable.

Copper has been used as the alloying element of silver since early times when primitive peoples discovered the native silver-copper alloys. The fineness of the silver-copper alloys used in the arts and silverware industry varies generally from 750 to 925 fine. Some articles are made from alloys having the same fineness as silver coins, which in this country are 900 fine. In England and the United States the accepted standard for silverware is 925 fine and is called sterling silver. Most of the silver products we use are made from this composition.


Contrary to the usual belief, native, or pure, silver accounts for only a small part of the total production. Silver occurs in many ores, usually as a sulfide and is commonly associated with lead, copper and zinc. The silver content of the ore may vary from a few ounces per ton in lead and copper ores to hundreds or even thousands of ounces where silver is the principal value.

That silver will be used more than ever in the production of civilian merchandise after the war is an accepted fact with metallurgists and manufacturing authorities. This is made clear, they say, by the remarkable advances made in many manufacturing processes, alloys and materials and by the rigid tests of various types of construction under wartime operations.

While silver production in the Western Hemisphere has been slowed somewhat by such difficulties as labor shortages, experts point out that there is little danger of a silver shortage for years to come despite extreme war production needs. This is particularly true if the Treasury continues its policy of making government "free silver" available to industry.



TOUGH . . . but oh so gentle

 Little engine troubles soon become big, expensive problems, if neglected. And one of the most common causes of engine trouble is worn-out piston rings.

Whenever your engine shows signs of ring failure—oil-pumping, smoke and

loss of power—go to your motor service man. He will show you how to save oil, check cylinder wear and step up engine performance—with Hastings Steel-Vent piston rings.

HASTINGS MANUFACTURING COMPANY, HASTINGS, MICH.
Hastings Mfg. of Canada, Ltd., Toronto

★
IT'S A PRIVILEGE
TO BUY WAR BONDS



HASTINGS STEEL-VENT PISTON RINGS



TOUGH ON OIL-PUMPING GENTLE ON CYLINDER WALLS

GIVING A MACHINE THE BREATH OF LIFE



Photo courtesy
Fowich Airflow Co.



IN BUILDING precision machinery, it is usually the combination of trained mind, skilled hands and *right file* that provides the final assurance of good performance.

No single type of tool has yet been discovered which can be applied with greater versatility toward "making things work" than files. Their production is an "industrial art" which can well be a tool manufacturer's sole business.

For 80 years Nicholson has been making files and nothing else. Nicholson devotes its field studies wholly to files for industrial production, sharpening tools and implements, working different kinds of metals and other materials.

So, when you ask your hardware or mill-supply dealer for a file for a specific purpose, you can be sure that in Nicholson or Black Diamond brands you can obtain exactly *The right file for the job*—under the guarantee of *Twelve perfect files in every dozen*.

FREE BOOK, "FILE PHILOSOPHY." For production heads, foremen, mechanics, repair and machine shop operators. Shows scores of regular and special-purpose files.

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FILES FOR EVERY
PURPOSE

NICHOLSON
U.S.A.
MADE IN U.S.A.

They Get There First

Continued from page 47

one of several TCC bases, probably Alliance, Neb., Sedalia, Mo., or Louisville, Ky. The enlisted ground crews are meanwhile trained in their specialized tasks.

The final phase of training is conducted at Laurinburg-Maxton Army Air Base near Ft. Bragg, N. C. Here the Troop Carrier Command crews meet for the first time their future passengers in battle—paratroops, glider infantrymen, and artillerymen. These are specially trained ground troops of the Airborne Command. After two to three months of practice in hauling and dropping troops, supplying them by parachute during maneuvers and evacuating "wounded," a Troop Carrier squadron is ready for assignment overseas.

The TCC's glider pilots, noted throughout the AAF as the toughest flyers in the business, are trained in the same commando course given to the Airborne troops they will carry. Reason for this is the unpleasant truth that once a glider pilot lands his craft the only way to get home is by foot or in another vehicle. When the landing is behind the enemy's lines the glider pilot must fight his way back. The TCC gives him combat training at its Glider Pilot Training Center, Bowman Field, Louisville, Ky.

Standard glider of the AAF at present is the CG-4A, a 15 place machine of fabric and tubular steel whose capacity for absorbing punishment without injuring its passengers is legendary. CG-4As have been rammed into houses, set down in lakes, crash landed in forests—but their passengers are seldom hurt. With a gliding range of about ten to one, it will travel forward ten feet for every foot of altitude. Its wing span of 83 feet 5 inches, compares favorably with that of a Flying Fortress. It is 98 feet long and weighs 3,600 pounds empty. Carrying a flight crew of pilot and co-pilot the glider is towed by the C-47s at the end of a 350-foot nylon tow rope, either singly or two to a transport. The elastic quality of the nylon, which takes up most of the shock as the glider is towed into the air, is largely responsible for the success of glider operations. The gliders have upturnable noses which allow a jeep or small field piece to be run aboard. Although the primary purpose for which Troop Carrier crews are trained is aerial invasion, its pilots run passenger and freight routes under the noses of the enemy; evacuate wounded men, and haul combat engineer battalions which special-

Continued to page 152

AUTO-LITE SPARK PLUGS

IN SERVICE ON EVERY FRONT



"Dang it, Uncle Rafe, quit playing paratrooper . . . comp'ny's a'comin' and maw can't find the bedsheet!"

NO CATCH...TO "PLUG-CHEK'S" GAS SAVING!

Auto-Lite's "Plug-Chek" Inspection Service can help save gas wasted by faulty, dirty or improper plugs. In actual tests by the American Automobile Association this spark plug service resulted in increased gas mileage up to 12%! Today some car owners get better results from "hotter" spark plugs than those which originally came with their car. This is particularly true because gas rationing so radically cuts the speeds and miles you drive. "Plug-Chek" will quickly show you whether your present plugs are operating "too hot" or "too cold" or just right. Get a "Plug-Chek" today!

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Carhartt

**BROWN DUCK
OVERALLS
For Those Extra
Tough Jobs**

WORK CAPS
Washable, comfortable and
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Here's another exclusive
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know about—Carhartt Brown Duck
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Built for those extra tough jobs,
these 11 oz. bib overalls and coats
to match are just the ticket for
structural iron and steel workers,
bridgemen, electricians, and line-
men, road builders, foundry men,
ship workers, truck drivers, freight
handlers and a hundred and one
other rough and ready occupa-
tions.

Made by the makers of the fam-
ous union label brand of Carhartt
work clothes, they're dependable,
wear-resisting and rugged. Back
three generations of overall mak-
ers who have backed the unions
for over 50 years—**BUY CAR-
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UNION MADE WORK CLOTHES

50 Years a Friend to Organized Labor

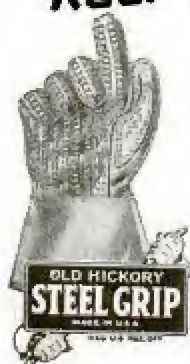
**KEEP MATERIALS
MOVING**

with Steel-Grip Gloves

With not a moment to be lost,
keep men at work and materials
moving with Steel-Grip chrome
tanned cowhide gloves. Steel rib-
bons over tough leather strips;
palm and fingers reinforced, for
utmost wear. Handle rough,
heavy, sharp materials with speed
and safety and sureness. Or what's
your problem? Over 4300 proven
Steel-Grip safeguards may give
you an immediate answer. Used by
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Canada: Safety Supply Co., Toronto



ize in reconstructing ruined landing fields.

The Troop Carriers reached Egypt in
time to help General Montgomery's Eighth
Army chase Rommel across Libya, hauling
gasoline, food, water, ammunition and
bombs. They flew in sandstorms reaching
up to 8,000 feet that half blinded the pilots,
pitted propellers and ruined carburetors,
but they kept coming so fast that fighter
planes returning from a mission often re-
fueled from a C-47 awaiting them with a
load of 100 octane. On return trips they
piled wounded British Tommies onto
stretchers and flew to hospitals on the Nile.

It was the Guadalcanal campaign which
helped to develop one of the most hard-
bitten and overworked airlines, the Troop
Carrier aggregation known as "SCAT"
(Central Pacific Air Transport) which in
one month hung up a record of 1,853,000
ton miles of cargo and passenger flying.
Operating from New Caledonia and Espiri-
tu Santo, SCAT boasted that 90 percent of
its planes were always in flying condition
despite tropical storms and primitive main-
tenance conditions. It flew 2,810 missions, a
total of 1,303,000 miles or fifty times the
distance around the world at the equator.

At its School of Air Evacuation at Louis-
ville, Ky., the TCC trains flight nurses.
They are selected from the regular Army
Nurse Corps and former airline steward-
esses and given six weeks training in avia-
tion medicine, particularly the treatment
of patients in flight. Assigned to air evac-
uation squadrons overseas, they fly to the
front with personnel and equipment, su-
pervise the speedy conversion of the big
ships into hospital planes and care for the
wounded on the way back. With canvas
stretcher racks installed, a C-47 carries 20
to 24 litter patients per trip. Once offloaded
from hospital boats on this side of the At-
lantic, our wounded men often get a second
ride with the Troop Carrier Command to
army hospitals located as near as possible
to their homes. During one operation from
an east coast port recently, the TCC moved
over 600 patients in ten days to hospitals
throughout the east and middle west.

"You made the lap of the trip that always
seems the longest, the shortest," said one
wounded soldier to his flight nurse. "We
sure are grateful."

In stories like this, and in the awards for
bravery and unit citations worn by its
thousands of officers and men, the I Troop
Carrier Command sees the proud justifi-
cation of its insignia and its motto—A giant
falcon carrying an armed soldier in its
talons, beneath it the Latin words: "Vincit
qui primum gerit—He conquers who gets
there first!"

PRESIDENT TAFT GAVE THE STARTING SIGNAL

IT is June 1, 1909. For weeks the papers have carried the exciting news. Now, before New York's City Hall five "horseless carriages"—an Acme, a Shawmut, an Itala and two Model-T Fords—stand hub to hub.

Anxiously mechanics make final adjustments. Then, from the White House, President Taft flashes the starting signal. And America's first transcontinental auto race is under way.

West of St. Louis, seven-day rains had turned the roads into quagmires. Across the prairies and in Colorado average speeds were cut to ten miles an hour.

At Cheyenne, Wyoming, the big Itala quit the race. The others

plowed on. Near the summit of the Cascades they fought their way against towering snow drifts.

Days later, Ford Car Number 2—the winner—entered the gates of Seattle's Alaska-Yukon-Pacific Exposition. It had crossed the continent in 22 days and 55 minutes, with New York air still in the two front tires!

As he awarded the trophy cup, Col. M. Robert Guggenheim said: "Mr. Ford's theory that a light-weight car, highly powered . . . can go places where heavier cars cannot go, and can beat heavier cars costing five and six times as much, on the steep hill or on bad roads, has been proved. I believe Mr. Ford has the solution of the problem of

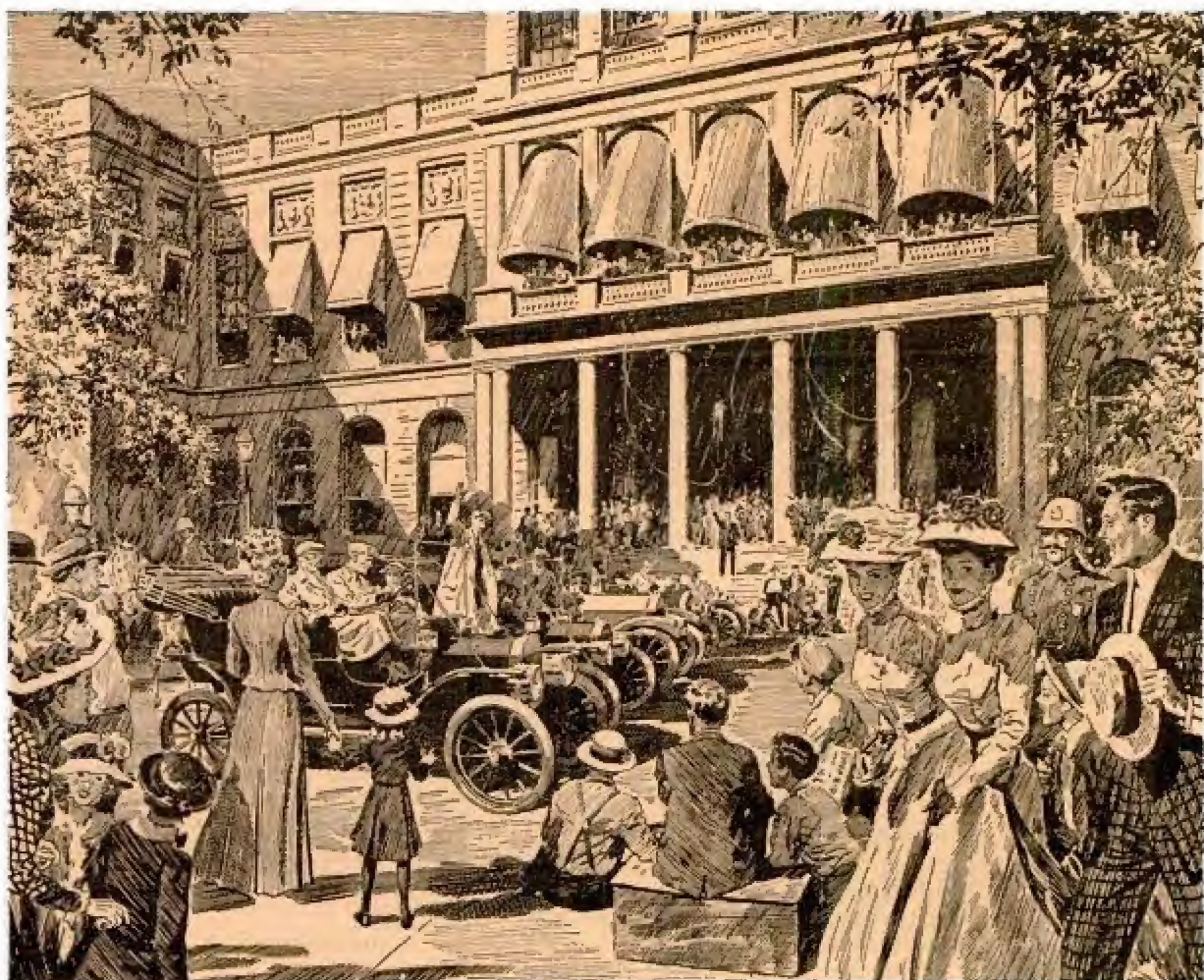
the popular automobile."

The proof of that statement no longer rests in a single car, which won a race, but in the 30 million cars and trucks Ford has built since then. And today millions of them are providing reliable, economical transportation for wartime America.

Meanwhile the inventive genius and the precision skills associated with the name *Ford* continue to serve the nation in the mass production of giant aircraft and other means to victory.

In the days of peace ahead, Ford's resourcefulness in developing new ideas and methods will again produce soundly-engineered motor cars, priced within reach of the largest number of people.

FORD MOTOR COMPANY



VICTORY GARDENERS

Dirt won't stick to hands covered with DU PONT "PRO-TEK"

Before starting work, rub on "PRO-TEK" like a cold cream



After work, grime and dirt wash right off

This cream acts like an invisible glove

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TODAY IT BELONGS TO THEM



★ Helping to guide army vehicles on strange roads. Tomorrow the new improved HULL COMPASS will be available to you at your dealer's.



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WHIP WORMS**



...you can free your dog of all these worms

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COMBINATION TREATMENT **WORM CAPSULES**

Used by leading breeders. At leading pet, drug, department stores, 50¢ a package (double size, 75¢). Packed two ways: for puppies, for dogs.

Featherweights on Wheels

Continued from page 79

attached to the chassis and the other end clamped to the body, replaces each conventional set of spring leaves. The springing action of the usual spring is duplicated by the twisting action of the bar, at a considerable saving in weight.

The trend of the railroads toward lightweight equipment began with the advent of the streamlined passenger trains pulled by Diesels. The indications are that even these trains can be replaced by still lighter engines and cars with no sacrifice of safety or comfort. Figures have been prepared for a new Diesel road locomotive that would be 137 tons lighter and 750 horsepower less powerful than present Diesels and that yet would have a top speed and tractive effort comparable with present engines. Weight reduction would be made possible by using Diesel engine units of smaller cylinder bore. This would reduce the length and hence the weight of the engine. Other refinements would include aluminum fuel tanks and lightweight flooring. Doing the same work as one of the present Diesels, such a lightweight engine would consume 145,000 fewer gallons of fuel oil and 900 fewer gallons of lubricating oil per year, allowing for 6,000 hours of operation with a 60 percent load factor.

Already in use on the Santa Fe and Burlington systems are a few lightweight passenger cars designed on the semi-monocoque principle, using a skin-stressed body on a fabricated and welded frame. These Hill cars employ a coil-spring suspension that gives a unique floating ride. Of about the same weight as standard lightweight railroad cars, the Hill cars are said to have a high factor of safety.

Before the war, Bethlehem Steel had completed a few dozen box cars and hopper cars of a high tensile, rust-resistant steel that provided a weight reduction of 15 percent. Additional weight economies are anticipated.

Weight engineers tell about the time, not so long ago, when an airplane builder pushed his new model out of the hangar, invited four friends on board, and revved up his 65-horsepower engine for the first test flight. To his surprise the airplane didn't even budge on its wheels, so heavily was it loaded. Weight engineering has come a long way since then, but the engineers feel that even now their work has hardly begun.

☞ To learn where to buy commercial products described in these pages, see the index.

"I think I'd better stop now"

**When Long Distance Says—
"Please limit your call
to 5 minutes"**

That's a good suggestion to follow. It means the lines to war-busy centers are crowded. It's a friendly, thoughtful act that helps the other fellow—and then some day turns right around and helps you.



BELL TELEPHONE SYSTEM



Millions of tons of America's food get
to the stores and markets regularly be-
cause AC Spark Plug reliability keeps
the trucks in service. Owners of those
vital trucks save gasoline and lengthen the
life of their spark plugs by having plugs
cleaned and adjusted every 3,000 miles.



CLEAN PLUGS SAVE
UP TO ONE GALLON
OF GASOLINE IN TEN

AC
SPARK PLUGS

DO MORE THAN BEFORE—BUY WAR BONDS NOW

Heroes of the "Hump"

Continued from page 87

had become one of the biggest and busiest air centers. American engineers, pilots, and mechanics had accomplished the impossible. By expending a little effort, the Japs could once have taken Assam with its sleepy tea plantations and rice paddies. Now they know it is too late and the best they can do is drop an occasional bomb from great heights and announce to the world "China Wing wiped out."

There is keen competition between the various fields. The men keep a "score board" of the tonnage they carry, and watch it as avidly as they ever watched baseball returns. There is also competition over which unit has the best mess. The pride of one group is an ingenious stove made of two gasoline drums with the ends knocked out. The drums were welded together and set up on supports, leaving room for a grate beneath. Insulation was provided by a mixture of soil and cement. Out of this stove come roasts of buffalo, camel and goat meat to be served alongside wild pineapples, mangoes, carrots, and the dehydrated and canned rations.

President Roosevelt paid tribute to the valiant flyers of the Hump early this year with a radioed citation to the entire India-China Wing. The citation, first of its kind to a non-combat outfit, was for "exceptionally outstanding performance in the face of almost insurmountable odds."

Soon the Hump route will be augmented by the new Ledo Road across North Burma which is being built through the jungles by U. S. Army engineers. But until land or sea supply routes are opened up, the men of the India-China Wing will be flying round the clock to keep a brave ally in the fight.

Revolution on Rails

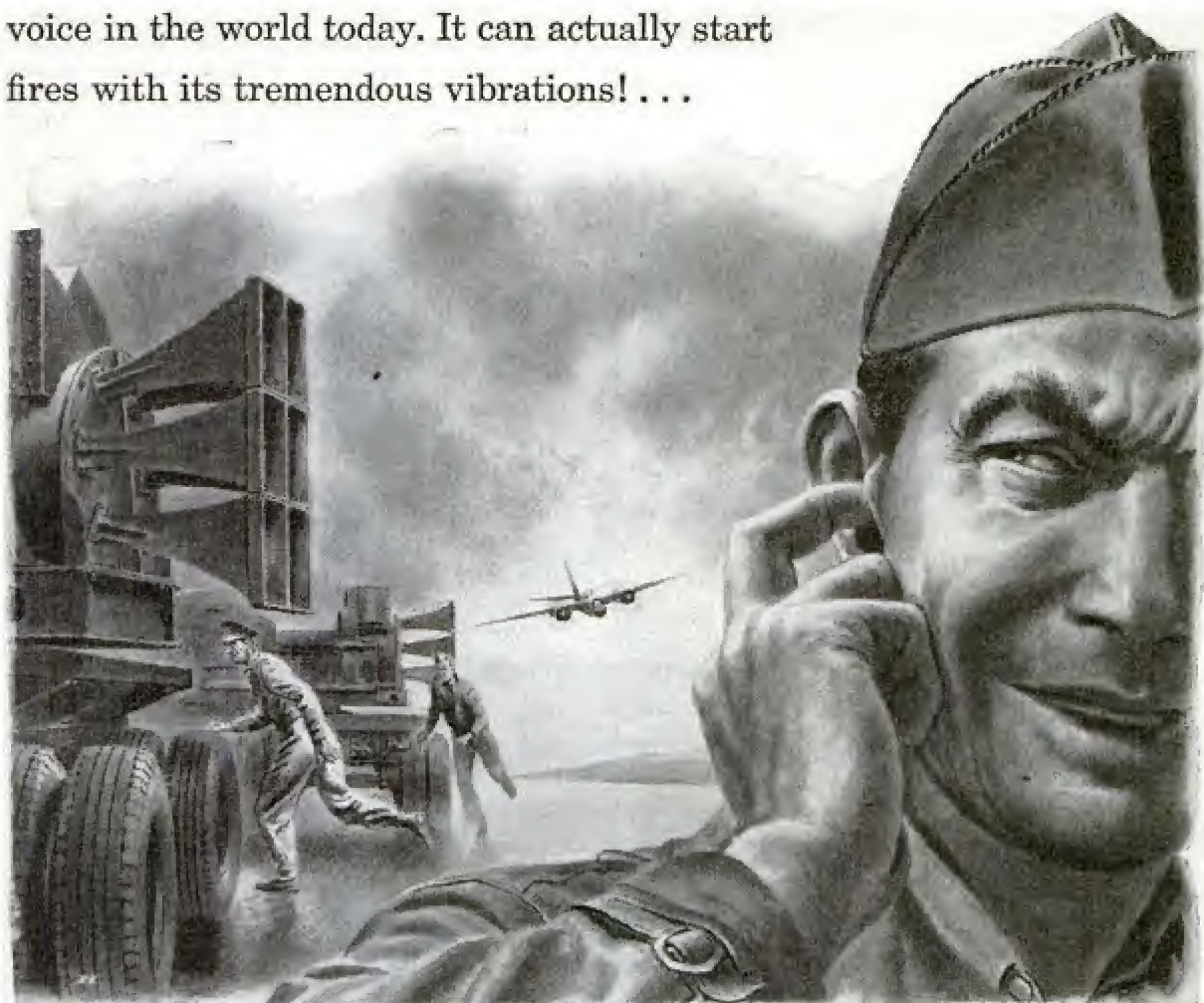
Continued from page 25

covered that control cooling of new rails prevents the shatter cracks which form the nuclei of the fissures.

The Southern Pacific has pioneered a number of railroad safety devices. One is a boiler drop plug, a device to release steam into a locomotive firebox when water sinks below the top of the crown sheet in the boiler, threatening explosion. If the boiler water level drops low enough to uncover the crown sheet, a fusible metal which holds the button-like center in the body of the brass plug gives way and the whole button blows into the firebox, releasing

Continued to page 158

"BIG JOE" CAN BLAST A HOLE THROUGH A FOG!... It's the air raid siren that's guarding Pearl Harbor and hundreds of American towns and cities...and it's got the loudest mechanical voice in the world today. It can actually start fires with its tremendous vibrations!...



BACK THE ATTACK WITH WAR BONDS!

"Where does Big Joe's power come from?...I'll tell you!...From the same engine that used to hide under the hood of a Chrysler...the very same engine that's helping to push thousands of General Sherman tanks toward Berlin and Tokio!"

WAR PRODUCTS OF CHRYSLER DIVISION

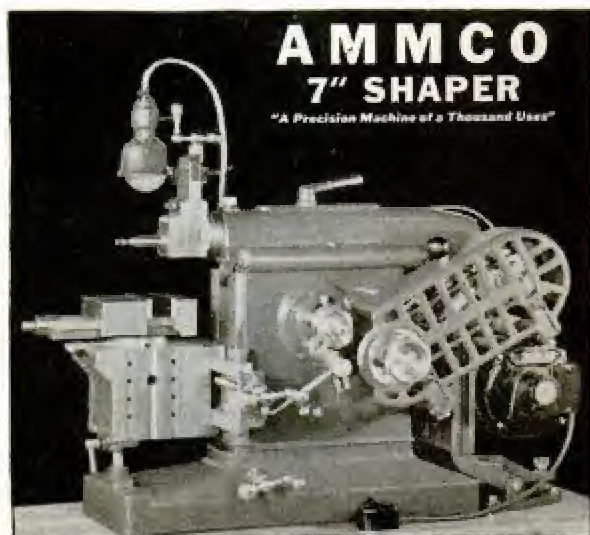
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A wide variety of jobs can be done accurately, quickly, easily, and economically on the AMMCO Shaper (7" stroke).

Construction incorporates many features you would expect to find only in larger, more expensive machines... For example: WAYS of ram, tool head, and front face of the main frame are of the "VEE" type, hand scraped to insure accuracy and long life. Available for stationary installation or as portable unit.

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ALLIED RADIO CORP.

833 W. Jackson, Dept. 5-G-4, Chicago 7

ALLIED RADIO

steam to smother the fire. Railroads generally are adopting alarm devices to indicate low water in the boiler.

Using a system like that employed in spraying paint, the Baltimore & Ohio Railroad developed machines which spray metal so that worn metal parts may be reclaimed at about two-thirds of the cost of the arc-weld process. Under the new system, a layer of metal is built up on the worn surface, just as a paint spray builds up a layer of pigment on a surface.

Most of this research is behind the scenes. What you see is the steam-snorting iron horse on the straightaway. Sleek steel horses like the new "Mohawks" of New York Central that whirl the Twentieth Century Limited through on schedule time and then pick up a heavy freight. Water is scooped up from 1,800-foot track pans, automatic stokers feed the fireboxes, automatic controls stop the trains if a signal is passed up and so efficient are the locomotives that one tender-full of coal lasts 600 miles.

Thus, through wartime research and improvements, the railroads are getting ready for the revolutionary changes to come.

Roughriders of the Deep

Continued from page 53

fought from below deck had no knowledge except word passed from mouth to mouth on how a sea fight was progressing. Now an officer on the bridge plays the part of commentator and describes the action, blow by blow, over the public address system to crew members who are stationed in the turrets and the engine spaces.

The clanging of an alarm gong and the shout of "All Hands, General Quarters," is the signal that sends a destroyer's crew to their battle stations within about a half minute. Each man on board has a job. Cooks and stewards take their stations in first aid and in the damage control squads. Some serve as ammunition passers.

Battle ports are closed, the steel doors and hatches that give entry between the hull's watertight compartments are shut and dogged down, and the men in the engine and fireroom spaces settle down to the task of maintaining their power plant at utmost efficiency. Engineroom noises can be heard up on deck as the speed increases and the steady roar of the deck blowers that are sending gales of wind down into the firerooms become louder.

At nightfall comes the command: "darken ship." Canvas curtains are draped over the companionways and every light that

Continued to page 160

SCREWBALL IDEAS ON BATTERY CARE #4

WATER
WATER



Bath tub brewers have the bright idea that since water weakens strong liquor and robs it of its kick, it will do the same thing to electrolyte, thereby weakening the power of the battery. They say not to add water, but don't believe it. A battery needs special care.

...THE WISE WAY IS PERIODIC RECHARGES!

KEEP your battery in tip-top shape by letting an experienced Exide Dealer check your battery regularly.

Restricted driving is hard on batteries. Rationed mileage keeps them from getting a normal charge from the generator, and can cause starting trouble unless certain precautions are taken.

In many cases, periodic recharges are essential, and with them, your Exide Dealer puts off the day when you'll need a new battery. When you *must* buy, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

EXIDES ARE USED IN MORE THAN 100 APPLICATIONS BY OUR ARMED FORCES



- 1 Don't buy *anything* you can do without.
 - 2 If you **MUST** buy, insist on dependable, long-lasting merchandise.
 - 3 Take care of the things you have. Make them *last*.
- "BUY MORE THAN BEFORE IN THE 5TH WAR LOAN."



YOU CAN'T BEAT this to relieve TORTURE of ATHLETE'S FOOT

So
Many
Druggists
Say!



If you suffer from itching, burning soreness from cracked, scaly skin between toes — just feel how the first applications of medicated *liquid* Zemo relieve distress. Then Zemo, on contact, actually kills the germs that most commonly cause and spread Athlete's Foot.

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NOTE: For real stubborn cases buy *Extra Strength*

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Each day brings us nearer to the time we can offer you a Ta-Pat-Co that will have all the new features developed from years of experience in making hundreds of thousands of sleeping bags for the armed forces. This new lighter, warmer, more compact Ta-Pat-Co is worth waiting for.

THE AMERICAN PAD & TEXTILE COMPANY
GREENFIELD, OHIO

*In peace and in war, the leading manufacturer
of Life-Save Equipment and Sleeping Bags*

might be reflected outside is turned off. On the bridge, only a few tiny signal lamps glow in the darkness. The hooded lights that comprise the ship's interior battle lighting circuit, formerly pale blue, have been changed to ruby red. The deep red has the advantage of not affecting the pupils of the eyes. The ship's navigator can study a chart under the red chartroom lamp, then step out on the bridge with his eyes in immediate adjustment for night vision. Men and officers wear red "adaptation" glasses for a quarter of an hour before going on watch after dark. By the time they are called to duty their eyes have adjusted themselves for night seeing. Another new aid for vision is the polaroid glasses the signalmen and lookouts often wear to reduce glare when looking toward the sun.

Few of the men on our destroyers had ever been to sea before the war. They were clerks or factory workers or students or farmers, yet intensive training has turned them into capable seamen. They are fighting like veterans.

Parlor Cars With Wings

Continued from page 12

designed by Henry Dreyfuss. Plenty of leg room is provided for passengers and intimate grouping of seats back-to-back. The ship for day travel accommodates 48 passengers, and the night plane has berths for 24. It has a cruising speed of 240 miles an hour and range of 2,500 miles fully loaded. Interior features include polaroid windows, which permit adjustment to any degree of light, full-length plastic mirrors, room for small suitcases beneath the seats, and "pillow" radios.

In some designs, daytime seats can be converted quickly into roomy lower berths, with uppers swinging down from overhead. As an example of the detail in which Model 39 has been worked out, passengers will use special weight-saving soap bars made of paper wafers treated with soap.

Another newcomer designed for postwar airlines is the pioneer Douglas Aircraft Company's DC-7. It is reported to have reached the mockup stage and is said to be considerably larger than the company's 42-passenger DC-4. Built for transoceanic travel, the ship will carry 86 day passengers and provide sleeping accommodations for 76. The transport will be larger than any bomber now in service, according to reports, and will have a wingspread of 173 feet and three inches and a 123-foot fuselage. Speed is estimated at 400 miles an

Continued to page 162

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Power Tools

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hour, range at more than 4,000 miles, ceil-
ing at 40,000 feet, payload 58,000 pounds.

Giant flying boats built by the Glenn L.
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now operated by the Naval Air Transport
Service, are an indication of what the air
traveler can expect in the immediate post-
war years. The production version of the
Mars, the JRM-1, has two spacious decks.
When used as a hospital ship it can carry
84 litter cases and 25 attendants.

When these giants go to work for the air
lines, the peacetime traveler is due for a
thrill. What he wants to know in practical
American fashion is "how much?"

Pan American Airways has tried to an-
swer this question with a probable flight
schedule for 1948. It gives possible repre-
sentative fares for 22 cities around the
world, and is based on the company's plans
to operate a fleet of 150 super airliners,
some of which have already been ordered.

The schedule lists 10 daily flights from
New York to Bermuda. Time of the trip
is set at two hours and 40 minutes and the
one way fare is \$20.70, round trip \$37.26.
Other destinations, hours of flight from
New York and one way fare, include Fair-
banks, Alaska, 13 hours, \$97.50; London, 13
hours, 48 minutes, \$103.50; Buenos Aires,
21 hours, 36 minutes, \$162; and Sydney,
Australia, 42 hours, \$315. The schedule
boasts a week-end cruise to Paris leaving
New York at 3 p.m. Oct. 1 (Friday) 1948,
arriving in Paris at 8 a.m. the next day,
and leaving Paris Sunday night with ar-
rival in New York scheduled for 7 a.m.
Monday.

The schedule reveals you will be able to
fly from New York to Tokyo in 27 hours
and 36 minutes—that is, of course, if Tokyo
is still on the map in 1948.

Torpedo Cowboys

Continued from page 3

ing a submarine net, which is usually
mined and explodes if the top is touched,
they submerge and the rear man dismounts
and lifts the net to let the torpedo pass
beneath.

Underneath the hull of the target ship
they set the time fuse on the warhead, fix
it to the ship's bottom, then detach the
section enclosing the propulsive equip-
ment and make their escape before the
blast. Under ideal conditions the crew
should be able to rejoin their comrades on
the submarine from which the torpedo was
launched, but in the attack at Palermo
complete escape was impossible and the
three pairs of torpedo cowboys headed for
the Italian shore.

Coming Up!



...Two TIN FISH FOR TOJO!

UNTIL it is slammed straight for the belly of a frantically twisting, dodging Jap ship, a Navy aerial torpedo should be handled with care! And that is the way this deadly pair, cradled one over the other in a rubber barge, are being transported. In rearmament service these big rubber boats provide their lethal loads with a "safety zone" . . . a plump cushion of air that completely surrounds the cargo, safeguarding it against the danger of shock or collision. Many Evinrudes are used in such service, providing capable driving power and a high degree of maneuverability.



1 Servicing seaplanes is another job for which rubber boats are ideally adapted. For powering big rubber boats, Evinrude now produces a special model of its famed Lightfour, built with deep shaft, high-ratio reduction gear, and 360 degree steering that permits the boat to be maneuvered in any direction.

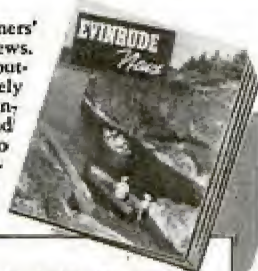


2 Up she comes, the day's work done! This photo shows the type of bracket widely used for mounting an Evinrude on a large rubber boat. Evinrude has developed many special mounting brackets to meet the varied needs of the scores of different types of small craft used by the Army, Navy and Marine Corps.

3 The Japs use outboards too, as is shown by this photo of a Jap outboard captured somewhere in New Guinea, and patched up by our boys to serve in ferrying supplies to the beach. Perhaps, by this time, it has been replaced by a sparkling Evinrude Speed-itwin, a "popular number" in the far Pacific!



FREE! Send for copy of 1944 "Owners' Edition" of the Evinrude News. A pictorial magazine that covers outboards in war and peace — profusely illustrated with photos showing Evinrudes serving the Army and Navy, and pictures of happy peacetime uses to follow! Write for your copy! EVINRUDE MOTORS, 5054 N. 27th St., Milwaukee 9, Wisconsin.



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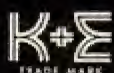


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*Accepted by American Medical Association
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There are cases in which deficient hearing is caused by a progressive disease and any hearing aid may do harm by giving a false sense of security. Therefore, we recommend that you consult your otologist or ear doctor to make sure that your hearing deficiency is the type that can be benefited by the use of a hearing aid.

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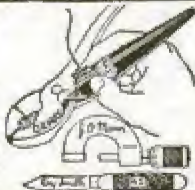
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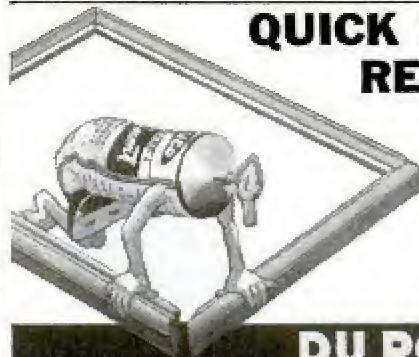
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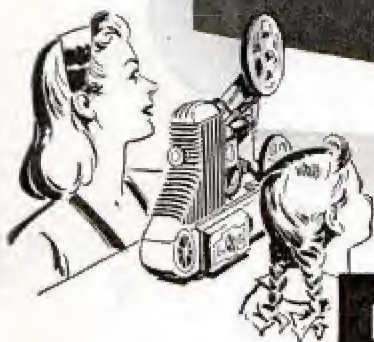


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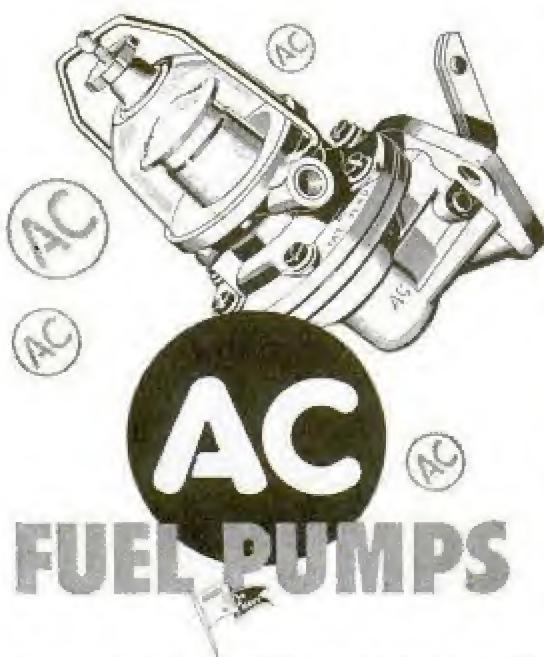
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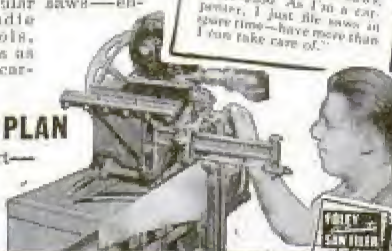
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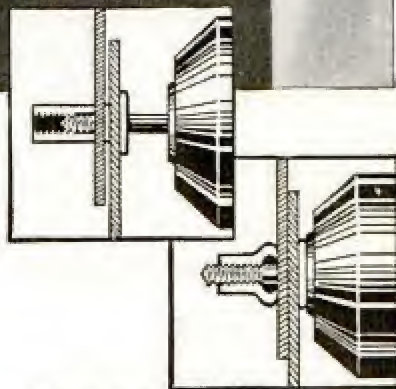
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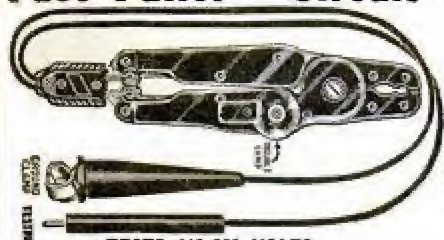
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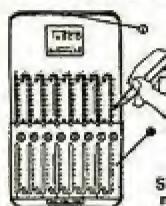


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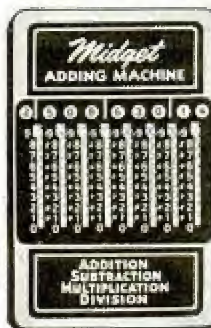
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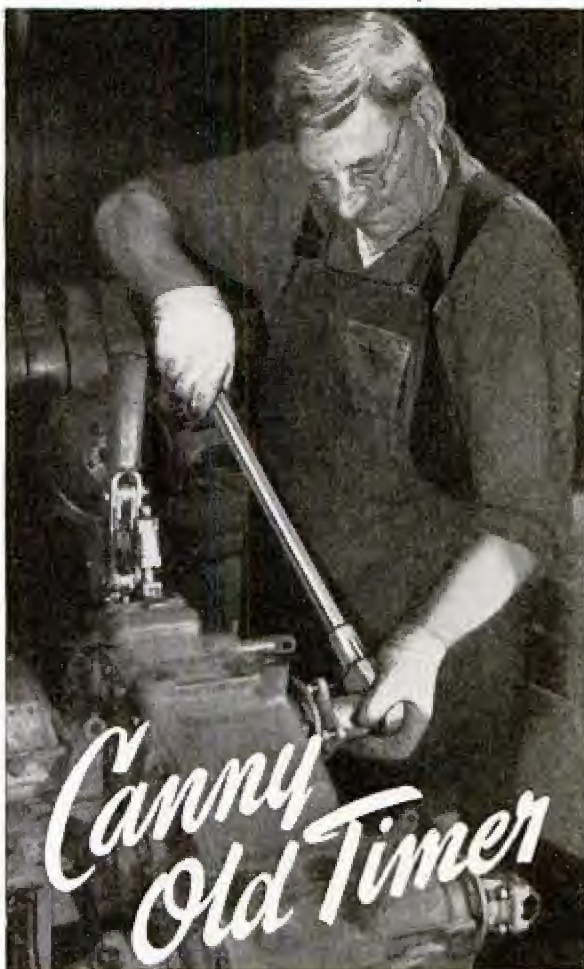
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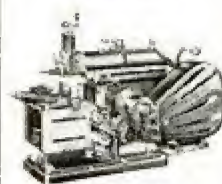
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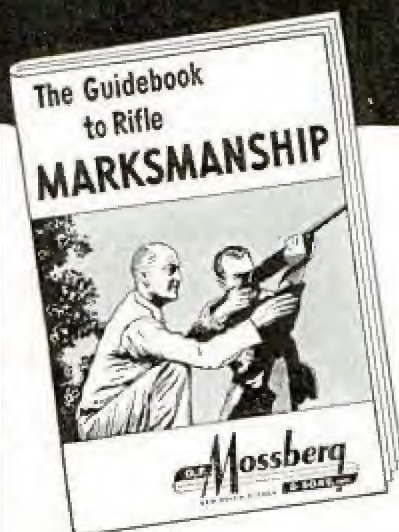
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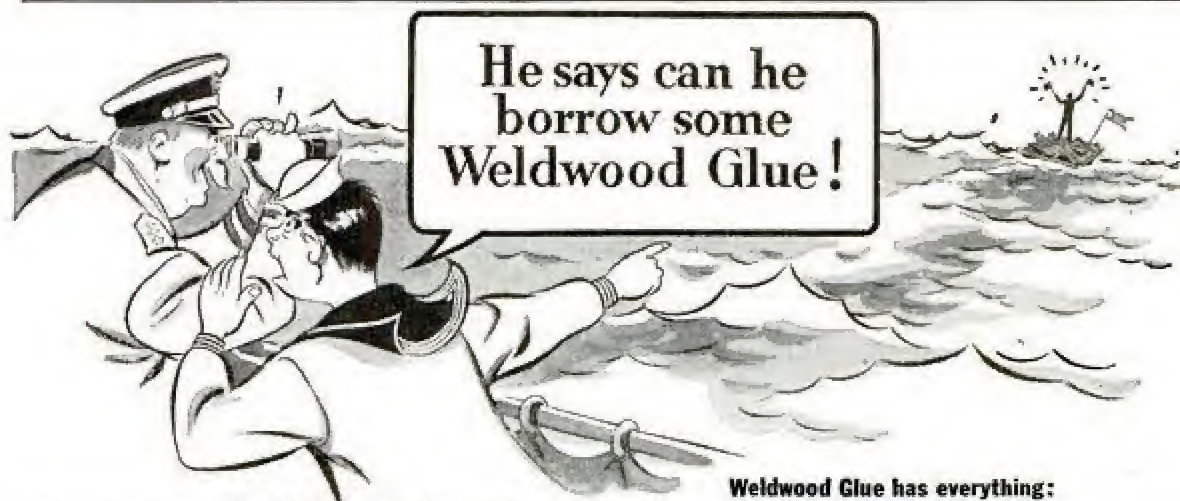
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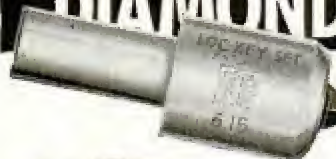
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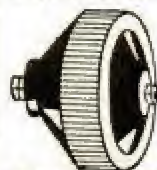
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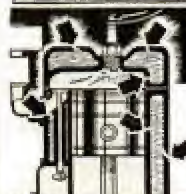
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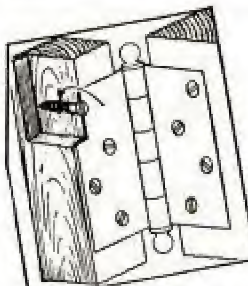
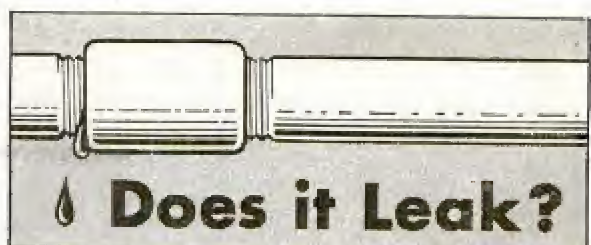
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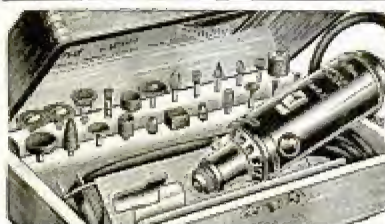
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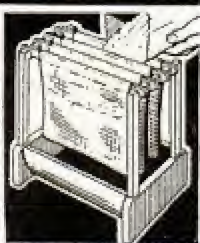
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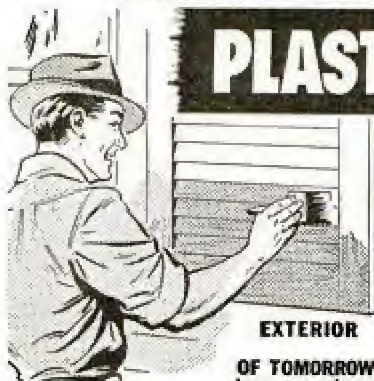
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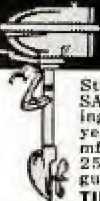
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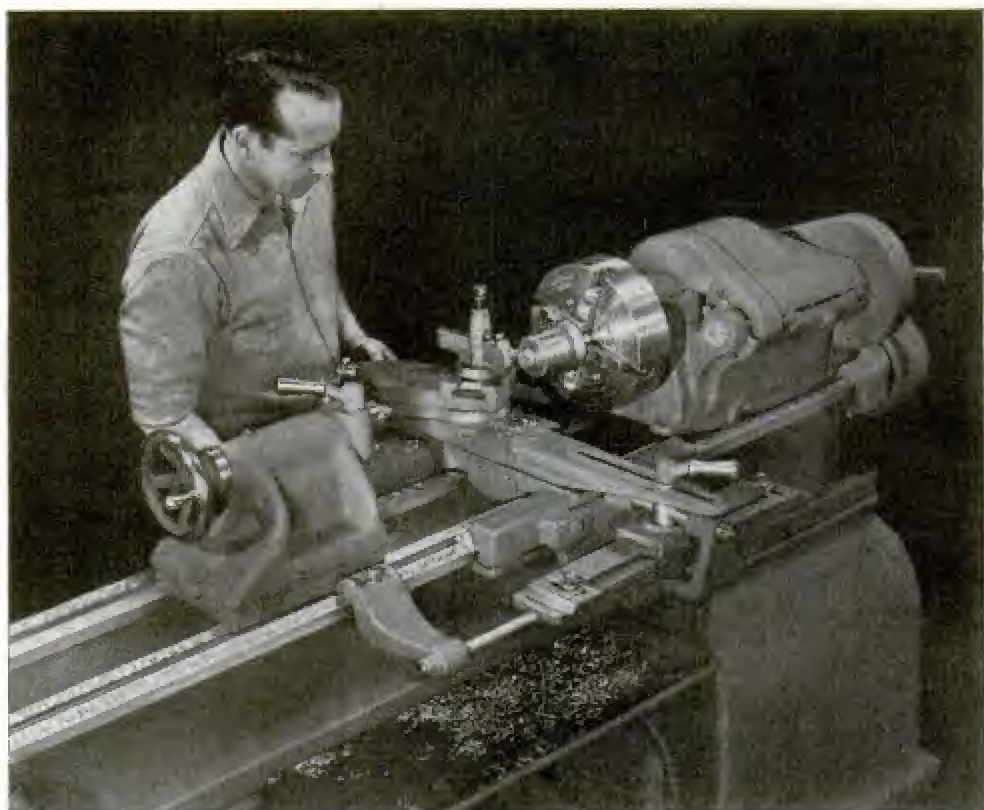
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